CIVIL ENGINEERING

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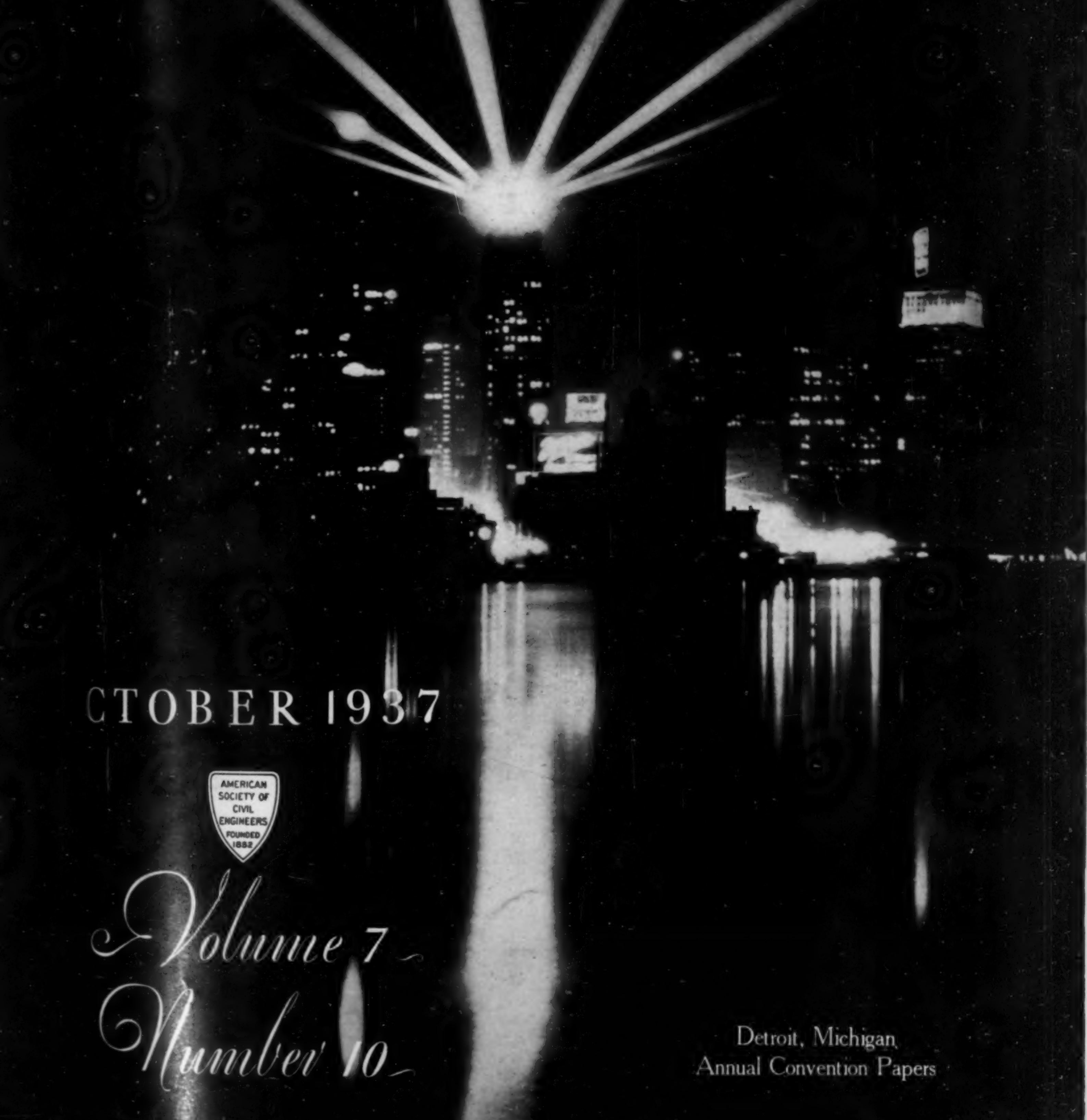

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AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

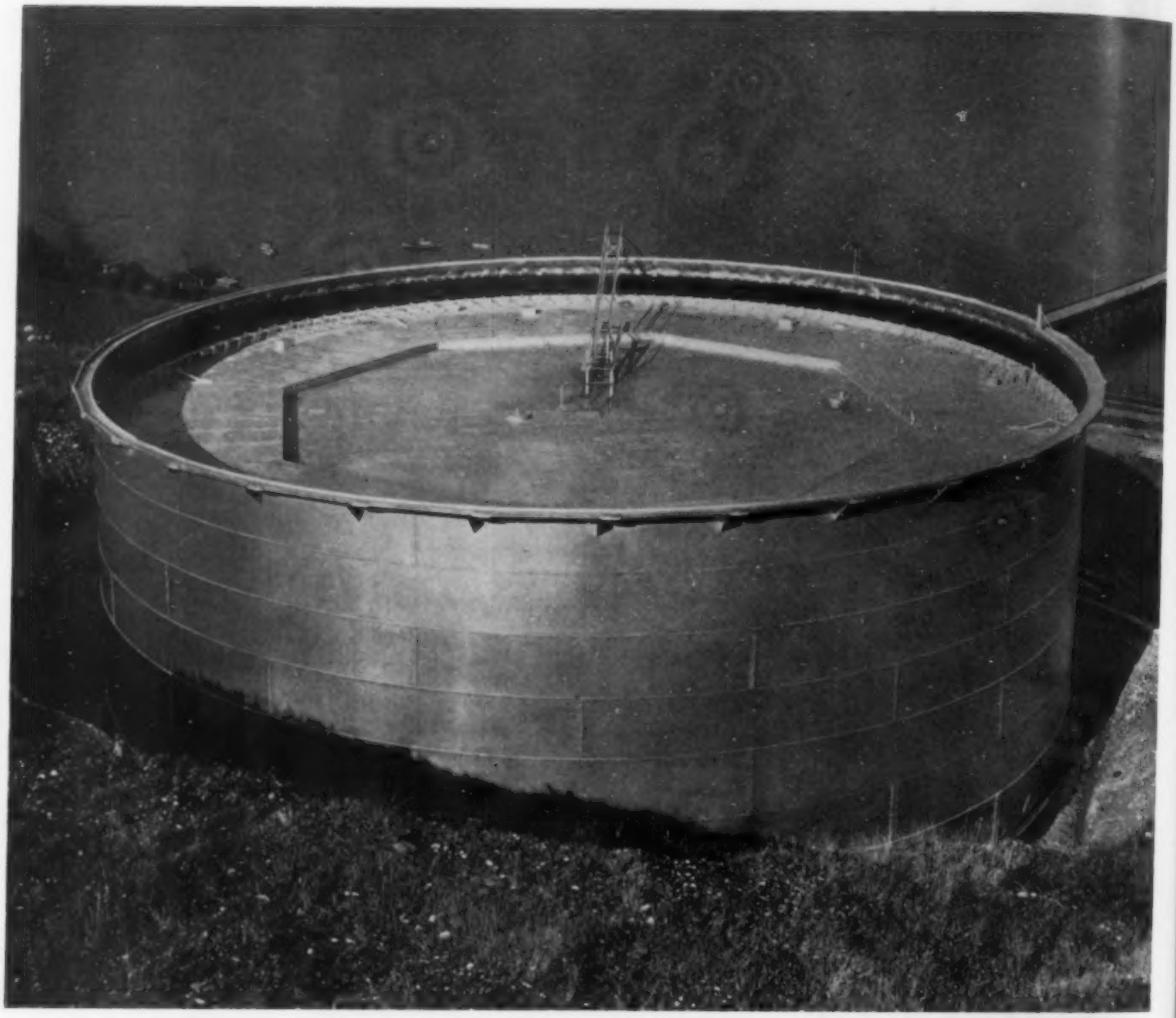
Volume 7
Number 10

Detroit, Michigan
Annual Convention Papers

From an etching by Paul T. Berdanier used in "The Sportman Pilot"

Transportation Essential to Progress

FRANCIS BACON (1561–1626): "There be three things which make a nation great and prosperous—a fertile soil, busy workshops, and easy conveyance for men and commodities from one place to another."



Among Our Writers

CHARLES A. HOWLAND served for over 8 years in the sanitary engineering division, New York State Department of Health. Since 1923 he has been in Philadelphia engaged in studies and reports on various municipal public-service functions.

F. D. STEWART has specialized in sanitary engineering work for 22 years. For the last 19 years he has been with the Ohio Department of Health—first as assistant engineer and since 1926 as principal assistant engineer.

EDWARD D. RICH, previous to his appointment as director of the bureau of engineering, Michigan Department of Health, served for 13 years as city engineer or assistant in various New York municipalities and for 5 years as a member of the University of Michigan faculty.

K. E. MILLER holds degrees of A.B. and M.D. He has been a pioneer in public health administration since commissioned in the U. S. Public Health Service (1914), and is now senior surgeon detailed as assistant chief of the Division of Domestic Quarantine.

CHARLES F. KETTERING is perhaps best known as inventor and manufacturer of the Delco starting, lighting, and ignition system for automobiles and as inventor of the Delco-Light farm-lighting system. He has received numerous high engineering awards, including the Franklin Gold Medal (1936) and the Washington Award (1936).

THOMAS H. MACDONALD has specialized in highway work for over 33 years, first with the Iowa State Highway Commission (of which he later became chief engineer) and since 1919 as chief of the U. S. Bureau of Public Roads.

LEROY C. SMITH has had about 30 years of experience in highway engineering work. For 20 years he has been with Wayne County, Mich., where he now serves as county highway engineer, director of parks, and airport manager.

MURRAY D. VAN WAGONER was in private engineering practice for 6 years previous to his election as drain commissioner of Oakland County, Mich. Elected in 1933, he is now serving his second 4-year term as state highway commissioner.

JOHN S. CRANDELL has been active in highway engineering for 33 years, including 13 years in a consulting capacity and 15 years in teaching—principally at the University of Illinois. He is the author of over 300 technical articles.

M. C. TYLER has been in the continuous service of the U. S. Engineer Corps since 1903. He served as division engineer in the Great Lakes Division from 1933 to 1935. He is now assistant to the chief of engineers.

JAMES H. CISSEL has specialized in bridge engineering for about 27 years. Since 1915 he has been a member of the faculty of the University of Michigan and has also carried on a consulting practice.

C. R. PETTIS, an officer of the U. S. Engineer Corps since 1904, has been interested in the hydraulics and hydrology of river floods, and has initiated an investigation of the hydrology of the Great Lakes.

SHERMAN MOORE, who has been with the U. S. Lake Survey since 1902, has been instrumental in developing hydrographic and hydraulic methods now used in that office, and has made a study of land movements as indicated by changing lake levels.

A. W. CONSOER has been a consulting engineer on water supply and sewerage projects for middle western municipalities since 1919. During the World War he served overseas as a captain of engineers.

H. H. KRANZ, after 13 years of supervising various kinds of construction, entered the employ of Cincinnati in 1926 as superintendent of highway maintenance. Since 1932 he has been engineer of highways in charge of Cincinnati's Division of Highways.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Civil Service and the Engineer

Continued Vigilance and Organized Follow-up Needed to Protect This Vital Element of Government

By Charles A. Howland

Associate Member American Society of Civil Engineers
Staff Engineer, Bureau of Municipal Research, Philadelphia, Pa.

To any unbiased citizen who critically examines the functioning of government, the importance of an efficient personnel is at once apparent. He does not need to be convinced that the public business will be most effectively and economically conducted by the man trained for his work, secure in his position, assured of promotion upon his merits, adequately paid, and unhampered by any requirement except that of serving the public interest. Obviously, the requisites of good public service are not met by the "spoils" system under which the selection of personnel is based on political activity and loyalty. They are met, however, by the civil-service system, or, as it is also generally termed, the merit system. The merit system has had to fight its way, but its adoption has spread and recently has had an encouraging impetus. It is of double interest to the engineer, for efficient service should have his support as a citizen and also requires his cooperation and active interest if it is to be made a force in advancing professional standards and the status of the engineer in public employ.

Effects of Politics and Depression.~It is unnecessary to enlarge on the value of civil service as an element in assuring the proper and competent design, construction, and operation of governmental works and services of an engineering nature. Rather the importance of energetic and effective support of civil service can be emphasized as a means of improving the status and welfare of the increasing number of engineers, particularly civil engineers, who are in government service. Shifts in political control from one party to another, so characteristic of democratic government, frequently result in the separation of engineers, solely for political reasons, from a service in which they have had years of experience. The effect of such replacement upon governmental work is usually detrimental. This turnover in personnel not only jeopardizes the service but lowers its appeal to competent persons as a career. In addition, there is the very real question of fair treatment for those who serve the public. These problems directly affect the security and work of a large number of our profession.

In a recent report of the U. S. Bureau of Labor Statistics, for example, it was shown that 80 per cent of the engineers under civil service were civil engineers and that this group constituted almost 20 per cent of civil engineers employed in December 1934. From the civil engineering viewpoint, therefore, civil service is no abstract matter of political ideals; it is a vital factor in the lives of a large proportion of our profession.

The depression has had its effect upon govermental employment and the merit system. In the efforts to combat the depression, there was a sudden and great increase in government employment, especially in the relief agencies of the federal government, and those employed in these emergency undertakings were not under the civil service. It is probably true that the extension of the federal civil-service regulations to cover these new governmental agencies has been delayed too long. A recent report made to a special committee of Congress by the Brookings Institution of Washington, D.C., recommended that, "in the interests of economy and efficiency," the civil service be extended to the bulk of federal employees not now under it.

Some Advances Nevertheless.~Those who conclude, however, that civil service has received a blow from which it will take many years to recover, are unduly pessimistic. As a matter of fact there has been marked progress toward the wider adoption of civil-service methods during 1937. Five states—Arkansas, Connecticut, Maine, Michigan, and Tennessee—enacted legislation in 1937 putting all or part of their state employees under civil service. The addition of these five brings the list of civil-service states to a total of fourteen. It is significant that Montgomery County, Maryland, will in future be subject to the rules and regulations of the employment

commissioner of that state. Little effort has been made, in general, to extend to the more than 300,000 county employees in the country any of the modern methods of personnel administration. The *National Municipal Review* for June 1937 lists numerous instances of the extension of civil service to cities. Los Angeles should have special notice because it is the first major city in the United States to place important department heads under civil service.

One surprising fact in the present civil-service situation is that, although relatively few of the many engineers employed by the federal government on relief programs have been classified under civil service and the proportion of engineers under civil service in the federal government would thus be greater in normal times than in recent years, the percentage of engineers who are under civil service is higher in federal employ than in either state and county or in municipal service. In other words the civil-service problem is quite as much a state, county, and municipal problem as it is a matter of federal organization. For this reason in particular, the action of the five states previously mentioned is especially encouraging.

That the merit system should continue its advance toward universal adoption is of increasing importance to civil engineers, because a marked shift in the proportion of civil engineers employed in public and private capacities has been under way. The study made by the Bureau of Labor Statistics revealed a decrease in the percentage in private employment from 54.3 in 1929 to 31.8 per cent in 1934 and, in the same period, the proportion of civil engineers in public employment increased from 40.0 to 48.5 per cent. This was the most pronounced shift of any of the engineering professions studied. No doubt an important cause of the increase in public employment was the enormous growth in federal government services under the work-relief programs.

Society's Cooperation Needed.~There is a need for extension of civil service in the states, counties, and municipalities, and toward this objective the American Society of Civil Engineers can make its influence most effective through its Local Sections. The Society can use its knowledge of the requirements for efficient service and the wide experience of its members in the public employ to assist in formulating sound civil-service regulations and in urging their adoption. But more than this is needed. Just to put a civil-service law on the books, even the most carefully phrased law bristling with "teeth," is not a guarantee that the ideal of the merit system has been achieved. The law must be honestly administered and enforced, and the vigilance of an organization concerned with efficient service rather than with political expediency can often do much to assure honest civil-service enforcement.

Mayor La Guardia of New York, in his recent report entitled "New York Advancing," expresses in the following words his appreciation of assistance given him toward civil-service reform:

"Cooperation of great value to the Commission was received during the year from professional men and women who advised and assisted in the conduct of these important technical examinations, often without compensation; from organizations and individuals conversant with personnel problems who have furnished information, advice, and counsel. . . ."

The Society need not confine its efforts to promotion of the merit system but can, very often, by voicing objection to wrong practices in the absence of civil service, show the need for improvement. Following a recent change of state administration in Pennsylvania, for example, the Philadelphia Section of the Society took occasion to protest the dismissal of obviously competent and experienced engineers from the state service.

Unionization Not the Solution.~That civil-service administration has not always been efficient cannot be denied. Probably for this reason some may feel that civil-service regulations are futile, and that the engineer, to secure protection for himself and his work, must turn elsewhere.

Where will he turn? There are, of course, organizations which, because of affiliation with labor unions, expect to achieve their objectives by use of the strike and other implements of labor warfare. The *News Letter* of the Civil Service Assembly for July 1937 says, "Public employee unions are sharing today's newspaper headlines with industrial workers. Their new activities have resulted in public personnel administrators, officials, and voters being called on to make decisions on matters of policy that only a short time ago were purely academic questions. For example, the possibility that the industrial organizing war between the C.I.O. and the A.F. of L. would eventually be extended to the governmental field became a reality when John L. Lewis granted charters to the United Federal Workers of America (federal employees) and to the State, County, and Municipal Workers of America." The *News Letter* goes on to describe the several organizations affiliated with each of the major labor groups. Probably every member of the Society is familiar with the instances where governmental employees, including engineers, have formed organizations closely resembling unions and have, on a few occasions, suspended activities in an effort not unlike a strike. However, professional engineers generally, including, it is believed, a large majority of the members of the Society, have felt that affiliation with a labor union was not the method which they preferred.

Combined Support for Merit System.~It would appear therefore, that universal application of the merit system to governmental service and the use of similar principles of employment in private service is the goal which professional engineers generally and the Society particularly should seek. Obviously, the effort will be more likely to succeed if all those whose objective is the same can cooperate and give to their demands the weight of added numbers. The Society, both as a whole and through its Local Sections, can join forces with other organizations engaged in promoting the merit system. An example of this kind of effort is the formation of the Pennsylvania Federation for the Merit System in which the Philadelphia Section of the Society joined with thirty other organizations to promote the adoption of the civil service for state employees in Pennsylvania.

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CIVIL ENGINEERING

October 1937

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Number 10

Health Problems of Touring by Motor

Sanitary Conditions of Roadside Camps and Water Supplies Leave Much to Be Desired

When Mr. and Mrs. Tourist pull into a roadside camp for the night, they have less than an even chance, in some parts of the country, of finding water that is actually safe to drink. Yet so accustomed have they become to safe water supplies and adequate sewerage at home, that they take these things for granted as more or less universal. The man in the next cabin who insists on looking at the well before taking a drink is put down as a crank. Doesn't the water come out of a pipe? Then it must be good.

Impure water is only one of the health hazards to which the traveling public seems more or less oblivious. Contaminated milk supplies and unsanitary treatment of food are also more common by far than many imagine. And all of these matters have become infinitely more important in the last decade, as America has taken to wheels.

A number of states, as well as the federal government, are doing something about it. In the first of the following papers Ohio's "Seal of Safety" roadside water-supply program is described. Publicly owned wells at frequent intervals along the highway in that state have proved their popularity and utility to the traveling public. In the second paper, the work of the Michigan Health Department in inspecting and grading cabin camps, resorts, and other tourist stopping-places is described, and the new problems created by the advent of the trailer are discussed. The third paper deals with the health hazards presented by various modes of travel, chiefly by highway, and stresses the need for local health units to handle the sanitation problems of each county or group of counties. These papers were presented on July 23, 1937, before the Sanitary Engineering Division, at the Society's Annual Convention.

Safe Roadside Water Supplies in Ohio

By F. D. Stewart

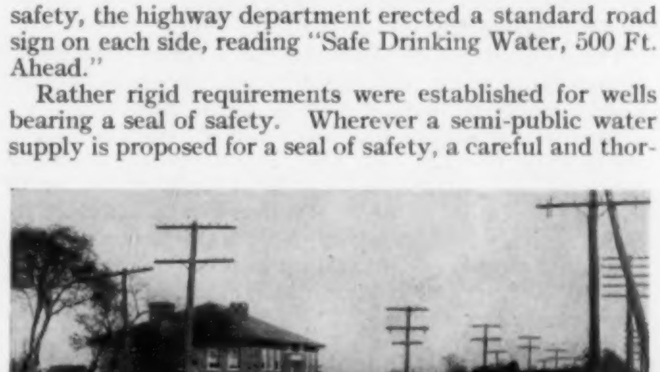
Member American Society of Civil Engineers

Principal Assistant Engineer, Sanitary Engineering Division, State Department of Health, Columbus, Ohio

About fifteen years ago the late Dr. John E. Monger, then director of the Ohio Department of Health, and W. H. Dittoe, M. Am. Soc. C.E., then chief engineer of the same department, were traveling about the state by automobile and were struck by the fact that except for the municipal public water supplies they were unable to get a drink of water that they could know was "safe." They were also aware that the vast army of tourists and travelers had no hesitation in drinking from any source, if facilities for securing the water were available. This brought forcibly to mind the real public-health hazard involved, and a realization that it was of great importance. The situation was receiving little attention from health authorities, except for the occasional condemning of wells from which contaminated samples were secured. Even then, condemned roadside wells, unless they were dismantled, continued to be used.

Thus was born the Ohio "Seal of Safety" idea for roadside and semi-public wells. The primary object of the campaign which was inaugurated was to advertise to motorists that a drinking water was at hand which could be approved by the state health department. The assistance of the highway department was enlisted, and wherever a well was found which could be given a seal of safety, the highway department erected a standard road sign on each side, reading "Safe Drinking Water, 500 Ft. Ahead."

Rather rigid requirements were established for wells bearing a seal of safety. Wherever a semi-public water supply is proposed for a seal of safety, a careful and thor-



Signs Like This Are Growing in Number and Popularity

ough sanitary survey is conducted. The distance of the well from known contaminating influences such as manure piles or leaching privy vaults must be not less than 300 ft, and the slope of the ground must be such that the

A ROADSIDE WELL DRILLED UNDER THE DIRECTION OF THE OHIO STATE HEALTH DEPARTMENT

The Highway Department Cooperated to Provide the Fence and Turnout

well site is not in the direct path of drainage from sources of pollution.

Driven wells will not be sealed unless the drive pipe extends 25 ft or more below the surface of the ground, and drilled wells must be cased to the same depth. Dug wells are looked upon with the greatest of suspicion. However, in some parts of Ohio the only water available is from shallow sources. In these instances the dug well is examined carefully, and if the side walls and top are not tight, improvements are requested. After the well has been made satisfactory, the local health commissioner must procure at least two sets of samples, one set preferably during a period of rain. If these samples are satisfactory, the well is then sealed.

There should be a concrete slab around the top of all types of wells, so built that surplus water will readily drain away from the well (Fig. 1). In addition, the casing of drilled and driven wells must extend at least one inch above the top of the slab. For dug wells, a pipe sleeve through which the drop pipe will extend should be placed while the slab is poured and should extend an inch or more above the top of the slab.

Pumps with split or adjustable bases, chain pumps, and pitcher pumps are not approved. Acceptable pumps must have a solid base either cast on the standard or attached to it in such a way as to prevent the entrance of waste water into the well. We have found the most satisfactory pump arrangement to be one in which the casing extends about 18 in. above the top of the slab. A so-called sanitary base, mounted on top of the casing, supports the pump proper. The sanitary base is a tapered or bell-shaped casting and is standard equipment with many pump manufacturers.

SAMPLES TESTED FOR B. COLI

Samples collected from the wells are analyzed in a routine manner in the health department laboratory at Columbus. All samples must indicate negative results for B. coli in two 1-cc and two 10-cc portions. No actual bacterial count is made on account of the lapse of time between collection and analysis. Samples are always collected in duplicate, and if they are not entirely satisfactory, the well is resampled. Incidentally, samples will not be collected at all if the well surroundings and development do not meet the established requirements. If improvements are needed they are described in detail to the owner and he is encouraged to make them so that he may secure the advertising value of a seal-of-safety well.

At the beginning a small lead disk, bearing the words "Seal of Safety, Department of Health, State of Ohio," was attached to each approved well by a twisted wire car-seal. These proved unsatisfactory as they were too readily removed, and they were soon supplanted by small decalcomania transfers placed on the pump barrel. These transfers, it was found, wear off in a year or two, and they are now being replaced by metal signs.

GROWTH OF THE PROGRAM

During the first few years of the campaign, an aggressive effort was made to arouse the interest of owners of road-

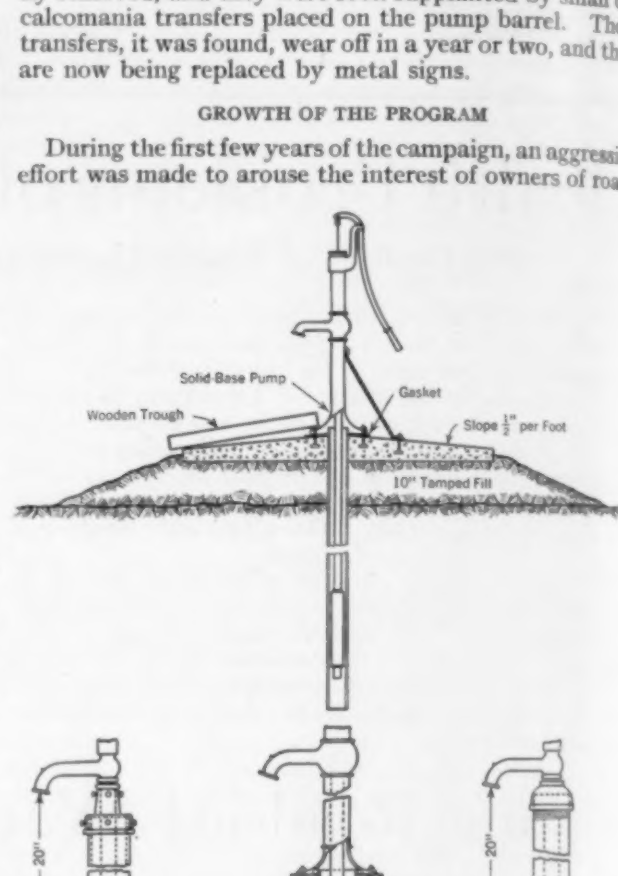


FIG. 1. APPROVED INSTALLATION FOR DRILLED WELL
Alternate Connection Details Shown Here Are All Acceptable

side wells in having a seal of safety and in making such improvements as might be necessary. Local automobile clubs actively supported the effort and in many cases would erect signs at the well. Over 300 seals were issued during the years 1924 to 1930, to wells at tourist camps, filling stations, parks, resorts, and rural schools and churches. The undertaking was also broadened to include semi-public water supplies under pressure at hotels, centralized schools, and so forth.

During the depression the seal-of-safety program was necessarily curtailed, but in 1936 the enactment of the Social Security Act made it possible to secure additional personnel, and a systematic check-up was begun. It was found that many wells once remote from contaminating influences were no longer safe. Where possible, corrections were required to be made immediately, under penalty of removal of the highway signs.

Many county health departments are now organized to a greater degree than ever before and the organization includes a county sanitarian, who in many instances is an engineer. This has been made possible by the U. S. Public Health Service and the federal Social Security Act al-

ready mentioned. By this means a much closer check on seal-of-safety wells is made possible.

As a result of the past year's work, two changes are planned. Often it is not possible for the motorist to locate the well which the highway sign has indicated to be 500 ft ahead. There may be two or more establishments on opposite sides of the road, each having a well or a water tap, but only one having a seal of safety. Hence plans have been made with the highway department to erect a large sign at every approved well. An agreement will be signed by the owner to permit removal of the sign whenever deemed advisable by the health department.

Further, it has been found that the discriminating tourist likes to know when the well was last examined. To advertise this, metal plates, bearing the word "approved" and the year, will be bolted to the sign post.

The Health Department is of the opinion that many publicly owned roadside wells are needed throughout the state. This conclusion was reached as a result of a project in well drilling engaged in during and following the drought of 1930 and 1931. In the latter year the legislature provided an appropriation for drought relief, which included an item of $10,000 for drilling and installing pumps and for other work on 65 or more seal-of-safety wells in the area that had suffered most—that is, the southern and southeastern parts of the state. This endeavor was intended to be largely educational, and the work was distributed over 23 counties. The rural wells over most of the area were shallow dug wells, and in many sections the idea seemed to be prevalent that only shallow ground water was obtainable. These shallow sources became dry after a period of drought and great suffering and inconvenience resulted. Only drilled wells were installed by the state, and of the 69 attempted, 48 were successful; this was considered a satisfactory showing. A second severe drought occurred in 1934 and the state wells were watched with great interest. Without exception they yielded their normal supply, and proved to be of great value to the residents of surrounding areas.

The project being a state undertaking, it was necessary that the wells be located on state highway property; and it was of course essential that sites be on permanent road locations. Where possible, the wells were located near cross-roads, or near small communities having no public water works, in order that they might be available to the maximum number of rural people.

Careful consideration was given to minimizing traffic hazards. In practically all instances sites were located on tangents, with clear vision in both directions. Most of the wells were placed near the highway property line, as far from the pavement as possible, and the highway department provided turnouts so that cars could be parked off the roadway while stopping at the well. In choosing well sites weight was given to the general attractiveness of the location, and an attempt was made to place the well in the shade of existing trees.

Requirements for State-Drilled Wells

The drilling and equipping was done under contract, under supervision of health department engineers. The well casing was specified to be standard wrought-iron drive pipe or standard steel lap-welded tubing, $4^1/_4$ in. in diameter. It was required to extend at least 25 ft below the ground surface, and 18 in. above the elevation fixed for the top of the concrete slab. The slab, 6 ft square, slopes away from the casing in all directions, and is separated from it by an asphalt expansion joint. The pumps are standard hand pumps with drop pipe and cylinder, capable of lifting at least 5 gal per min.

Thought Is Given to Attractiveness of Location for Roadside Wells

The average cost of the 48 successful wells was $138.37 each. This included everything but the supervision of the health department and the work of the highway department in building the fence enclosures and road turnouts. The average depth of the wells was 81 ft; the maximum, 288 ft; and the minimum, 30 ft.

Maintenance of these roadside wells is somewhat of a problem. Some expense is entailed in replacing broken pump parts, particularly handles. This was anticipated, and a part of the original fund appropriated was used for purchasing a supply of handles. These repairs are made by the maintenance division of the highway department.

These wells have proved to be quite popular with the traveling public. In some sections highway engineers have been able to install more of them; and the suggestion has been made that if the wells drilled for contractors' water supplies in the course of new highway construction are properly located, they can easily be made into suitable roadside wells at little extra expense. Residents and officials of parts of the state not included in the construction program of the health department have taken quite an interest in the idea of publicly owned roadside wells, and last year Summit County installed 18 of them, through the cooperative effort of the county health department, the county commissioners, the state highway department, and the WPA.

Safe Water at Roadside Parks

The most recent endeavor that will provide satisfactory drinking water to the traveling public is a project just undertaken by the state highway department to establish state roadside parks at frequent intervals along the state highways. These parks may be one or two acres or larger in extent, and they will be provided with a good water supply, toilet facilities, fireplaces, benches and tables, and parking spaces. The highway department is somewhat hampered by a lack of funds for this purpose, and present efforts are devoted to securing donations of park sites. It is often possible to select a site on

publicly owned property, and use will also be made of highway property, especially where roads are to be relocated.

It has been obvious that each park development would center around a proper well for drinking-water. The procedure has been for a representative of the state health department to accompany an engineer from the highway department on an inspection of prospective sites for parks. The location of the well is agreed upon, and suitable places for placing privies are indicated. A plan of the proposed development is then submitted for approval both to the health department and to the highway department. All the construction is to be done by the personnel of the highway department.

Tourist-Camp and Roadside Sanitation

By EDWARD D. RICH

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

DIRECTOR, BUREAU OF ENGINEERING, MICHIGAN DEPARTMENT OF HEALTH, LANSING, MICH.

THE value of the tourist trade in Michigan is exceeded only by one other industry within the boundaries of the state—the manufacture of automobiles. This is a statement based, not upon enthusiastic claims of advertising agencies, but upon information obtained through a traffic survey conducted from July 1930 to July 1931. The survey was not all-inclusive, and no specific information was collected from each tourist as to his expenditures; but from an estimate of the total number of tourists, and from records filed by tourists as to the number of days they expected to stay in Michigan and the type of accommodations they expected to use, it was fairly well established that this business amounted to a total of $274,000,000 for the year, spent by the occupants of 2,500,000 foreign cars.

The duty of the state to offer healthful surroundings to its summer visitors has been recognized by the Michigan Department of Health for many years. Before the advent of the automobile, resorts of the community type had been established extensively in the state. In some of the larger ones a water supply piped from a central point was provided, but few had the benefits of a sewer system. Since a large part of the land on which these resorts were situated is composed of sand and gravel, water was readily obtained from relatively shallow, driven wells, and sewage was easily disposed of into the ground by means of cesspools or septic tanks. There seems to be little definite evidence that the sandy soil did not protect the wells from pollution as it was expected to do. As early as 1913 an inspector was employed to look into the sanitary condition of the resorts and give whatever advice seemed desirable for the maintenance of cleanliness and health.

After the War the rapid increase in the use of the motor car changed the nature of the resorts to a considerable extent. People who formerly stayed in a cottage for the vacation season began moving about from one place to another, and this called for new accommodations. The outgrowth has been the present tourist parks maintained by private enterprise or by municipalities, and the admirable system of state parks planned and constructed by the State Department of Conservation.

A TRAVELING LABORATORY

During 1920, 1921, and 1922, the resort inspection organization consisted of an assistant engineer from the Bureau of Engineering of the Michigan Department of Health, a laboratory technician, and a general helper. The equipment included a light truck fitted with a specially designed body which provided all the facilities necessary in a well-equipped bacteriological laboratory.

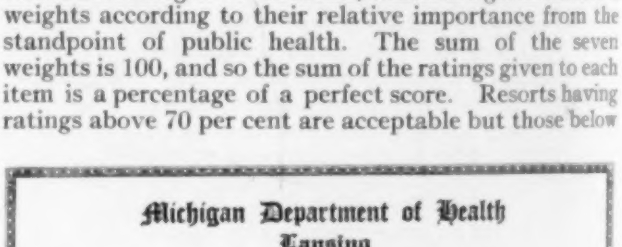
The procedure consisted of setting up the traveling laboratory in a conspicuous place, where the public would be led to avail themselves of the educational opportunities offered by the staff and by pamphlets carried for public distribution. Visitors were welcome and were given a thorough explanation of the work being done. Inspections of resorts in the vicinity were made and samples of water, milk, etc., were brought to the laboratory for analysis.

The analytical results obtained in this way were satisfactory and the educational value of the plan was of importance, but because of the loss of time in moving the laboratory from one place to another it was later found more practical to send samples to the department laboratories at Lansing, Grand Rapids, or Houghton, thus reducing the field work to inspections and collection of samples.

Resort inspections have been somewhat intermittent for various reasons, chiefly for lack of legislative appropriations. Now that county and district health units cover about two-thirds of the counties, the full-time sanitary inspectors in those counties make the inspections and send their reports to the Lansing office. This method provides fairly complete attention to the resorts, except in a few counties.

THE RATING SYSTEM ENCOURAGES IMPROVEMENTS

Inspection consists of examination and rating of each resort according to seven items, which are given different weights according to their relative importance from the standpoint of public health. The sum of the seven weights is 100, and so the sum of the ratings given to each item is a percentage of a perfect score. Resorts having ratings above 70 per cent are acceptable but those below


Michigan Department of Health
Lansing

Resort Sanitation

This is to certify that SAMPLE CAMP

HAS BEEN DULY INSPECTED AND HAS BEEN GIVEN THE FOLLOWING RATING

	Perfect Score	Score Awarded		Perfect Score	Score Awarded
WATER SUPPLY	20	20	CAMP SITE	10	9
SEWAGE DISPOSAL	20	18	FOOD HANDLING	10	8
MILK SUPPLY	20	15	BATHING	10	10
GARBAGE DISPOSAL	10	9	GENERAL CAMP RATING		89

RATINGS BELOW 70 PERCENT ARE UNSATISFACTORY

INSPECTION NO. 678

DATE OF INSPECTION AUG. 7 1937

Edward D. Rich
DIRECTOR BUREAU OF ENGINEERING

FIG. 1. CERTIFICATE OF INSPECTION GIVEN BY MICHIGAN DEPARTMENT OF HEALTH TO TOURIST RESORTS

70 per cent are regarded as unsatisfactory. A certificate (Fig. 1) is furnished in each case showing the marking for each item and the total.

This method of rating has stimulated improvements, especially among the better class of resorts, and has formed a basis on which criticisms of unsatisfactory features may be founded. It is felt that more practical results can be accomplished by setting up a standard of excellence to be striven for than by trying to control these places by enforcement of laws or regulations. It is human nature to rebel against dictation, and this attitude is likely to prevail when sanitary regulations are enforced by recourse to legal means. If a method of competition for higher grades can be maintained, and the urge to improve can be transferred from the enforcing authority to the resort owner, the spirit with which the work is carried on is much improved.

That resort owners value these ratings is shown by their use of them in advertising literature, where such statements as "Sanitary rating 95 per cent, health rating 98 per cent; sanitation approved by the State Department of Health" are common.

In a few instances local health officials have been advised to notify owners of places having ratings below 40 or 50 per cent that they must make substantial improvements or remain closed. Inasmuch as all merit is relative to a large degree, we feel that comparisons of faults and excellences in the various items form a basis on which the places can be fairly dealt with.

The inspection blank has a number of spaces under each division to be filled out by the inspector so as to give a rather clear idea of the local conditions even to one who has not seen them. With 30 or more persons making inspections, it is inevitable that some will be more lenient than others. For this reason each report is examined in the main office, and the marks are standardized as far as possible before the certificates are sent out. During the later years of the survey about 78 per cent of the resorts have attained a satisfactory rating.

WATER SUPPLY ALONG HIGHWAYS SUPERVISED

Closely related to the resort survey has been the supervision of sources of water supply along the main highways. The first systematic attention to this subject was given in the summer of 1925, and during subsequent years the survey has been extended to cover all state and federal highways and some county roads. This includes about 7,500 miles of highways, from which about 2,400 samples are collected each year (Fig. 2).

An inspector doing this work starts out on a predetermined itinerary arranged to economize time and travel. He makes a thorough examination of each water source, fills out a descriptive blank, and collects a sample. At the close of each day he mails to the nearest department laboratory the samples collected that day. The descriptive blank goes to the laboratory with the sample and is sent to the engineering bureau after the analysis is completed. If there appears to be nothing unfavorable in either the laboratory results or the description, the supply is approved.

After about two weeks, when sufficient samples have been analyzed, another representative is sent out to follow the same itinerary and call at the same places. If a source has been approved, he erects a metal sign about 7 by 9 in. in size on or near the pump, indicating the approval of the Michigan Department of Health. In cases where the supply is disapproved the owner is so informed and instructed that he must prevent the public from using the water. "Unsafe" signs are not posted, first, because the temptation to remove them would be too great; and second, because many unapproved sources are not so dangerous as to warrant the erection of a warning sign.

Throughout a large part of Michigan there are extensive deposits of sand and gravel containing an abundance

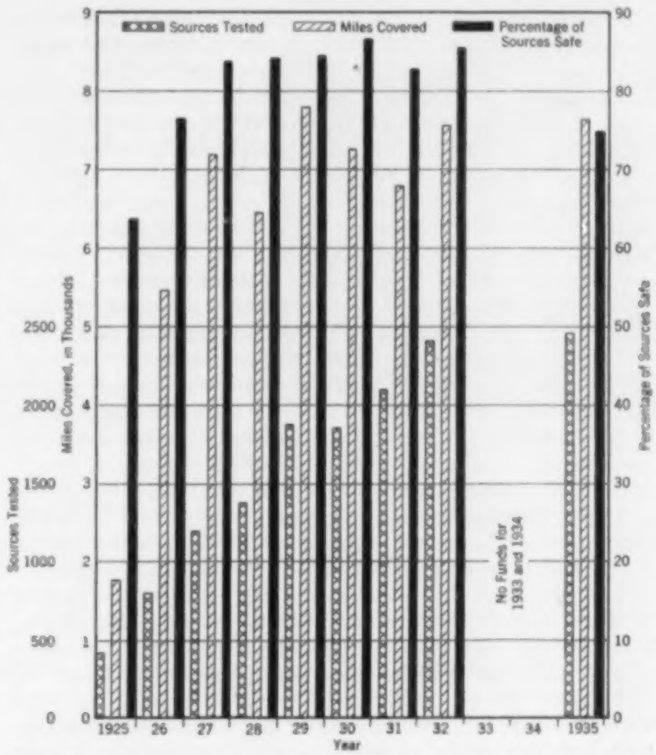


FIG. 2. MICHIGAN ROADSIDE WATER SURVEY OPERATIONS, 1925–1935

of good water which, if obtained through wells properly constructed and maintained, gives satisfactory laboratory results in a very large percentage of cases (Fig. 2). For this reason travelers in Michigan find safe drinking water readily accessible. The average distance between such sources is about 3.1 miles.

Continuous supervision of municipal water supplies is systematically performed by the state department of health. In cases where there is no doubt of the hygienic quality of the municipal supply, a sign reading "Public Water Supply Approved—Michigan Department of Health," is fastened to the post of the municipal limits sign erected by the state highway department. The widespread distribution of approval signs is sufficient to call the attention of travelers to the fact that safe water can easily be found, and we believe that they will quite generally refrain from using drinking water not labeled as approved.

It is a question how much actual public-health value may be ascribed to roadside and resort surveys. In the prevention of actual sickness and death from causes which this work might eliminate it probably does not accomplish any astonishing results. On the other hand, the indirect benefits arising from education of the public in health conservation is of great value in promoting the general health. Anything that can be done to draw attention to the danger lurking in unsafe water or milk supplies, the insanitary handling of food, and the production of nuisances, encourages people to be thoughtful about matters that may affect their health.

There is another benefit of a somewhat mercenary nature that should not be overlooked. Visitors from other states have so often expressed themselves favorably on

the methods of posting water supplies that we feel these surveys are of immense advertising value to the state of Michigan.

TRAILERS CREATE NEW SANITATION PROBLEMS

During the past few years vacationing in trailers has increased to such an extent that new problems of camp and roadside sanitation have been created. The problem of crowding of trailers in vacant lots in cities and villages is one that should be regulated by local ordinances. In Michigan one case has been decided to the effect that when a trailer is parked for a considerable length of time on vacant property it becomes a house and is subject to the local ordinances applying to houses. It is reasonable to enact ordinances to provide for the safety, comfort, and health of the occupants of these traveling homes and to protect neighbors from unsightly and disagreeable conditions when city lots are used for parking purposes.

Trailers should be regulated in such a way as to prevent accidents. Many of these conveyances are home-made, and provided with faulty brakes or an inadequate hitch to the tow-car. When trailers are parked near each other precautions against fire should be taken, probably by state law supplemented by local ordinances.

The large numbers of trailers now on the road have created a demand for parking places where conveniences for household uses can be provided. A safe water supply should be available within or near the parking place. Also, there must be some means of disposing of liquid and solid wastes. In Michigan, state parks and municipal tourist parks have so far been the places where these vehicles stop for stays ranging from a few hours up to a week or two, but there is a rising interest in the construction and operation of such parking places by private capital.

Some of the standard makes of trailers provide three different models—one with no toilet facilities; one with a toilet similar to the chemical closet; and one with a water-flush toilet. It appears that those responsible for the sanitation of public parking places should look forward to the construction of a sewer system providing an inlet to the sewer in the parking space of each individual car. Individual water taps should also be installed.

In Michigan state parks this plan would entail a considerable expenditure, for the parking spaces are rather widely scattered. Perhaps the consolidation of parking in a smaller area is the answer.

PROVISIONS FOR TRAILER WASTE DISPOSAL

For the present it would seem that points of disposal for liquid wastes should be provided throughout a parking area at short enough intervals that liquid wastes need not be carried more than 200 or 300 ft. In Michigan, where so much porous ground is available, a soakage pit 4 or 5 ft. deep, with a plank top and trap door, ought to give satisfactory service for the present. In connection with this it would be desirable to provide means for washing the pails used to carry the liquid wastes. Water from such washing should go into the pit. When the pit ceases to absorb water effectively it could be filled and the cover moved to a new pit.

Trailers usually contain a sink, and sometimes a lavatory. The wastes are disposed of through pipes extending through the floor in one or more places, but it is possible to collect the flow from these outlets at a single point and empty it into a container set on the ground, or into a sewer connection.

Garbage and rubbish should be placed in receptacles provided for that purpose, removed from the parking area daily, and disposed of in a sanitary way. Incineration is the most satisfactory means for disposing of rubbish. Garbage, if produced regularly and in sufficient quantity, might be utilized for feeding hogs or chickens; otherwise immediate burial or incineration should be practiced. Whatever the arrangement, facilities should be so well-designed and so convenient that the trailer occupant will not think of disposing of wastes in any other way than that provided for the purpose.

Full-Time Health Service and Travel Safety

By K. E. MILLER

SENIOR SURGEON AND ASSISTANT CHIEF, DOMESTIC QUARANTINE DIVISION, U. S. PUBLIC HEALTH SERVICE, WASHINGTON, D.C.

THE American public is notoriously travel minded, and rapidly becoming more so. Formerly travel away from one's own immediate vicinity meant going by rail or steamship, but these have now been overshadowed by highway travel. Railroads and steamships are so regulated by interstate traffic requirements that the health of travelers is fairly well safeguarded. In the case of highway traffic, however, the situation is quite different. The bus as an interstate common carrier does not furnish food or water to its patrons nor does it provide means for excreta disposal or sleeping accommodations. Travelers by bus, therefore, are almost wholly dependent upon sanitary conditions as they find them en route. Consequently, to a certain degree they are subject to the same hazards as beset the traveler in a privately owned car.

Travelers by rail and bus are few in comparison with those who go by private passenger automobiles. Literally, America takes to wheels and the open road on every possible occasion, not only for the sake of carrying on ordinary business activities, but more especially for recreation and health.

How trusting the American public has become! The subject of this discussion might as well be "Man's Faith in His Fellow Man." On the trail, every drop of water drunk, every meal eaten, every bed slept in, and every person encountered is a potential source of communicable disease. In spite of these facts, the American traveler goes merrily on his way with implicit confidence in the thoughtfulness and integrity of those whom he has never seen, to provide the necessary safeguards for his health. The frequency with which persons seeking renewed physical strength at resorts or in the wide open spaces return home broken in health as a result of typhoid fever or malaria is too well known to deserve special comment. In tracing the origin of a typhoid infection it is always customary to ascertain whether the patient was away from home at the beginning of the incubation period for the disease.

Granting that the traveler's home surroundings may be bad from a health standpoint, yet whenever he takes as much as a day's run, the odds are overwhelmingly in favor of his being subjected to health menaces more serious than those from which he came. Since a chain

is no stronger than its weakest link, a single danger spot may nullify all the health safeguards that have been taken along the way. The clear, cold spring flowing from a cleft in the rock along the roadside exerts an irresistible lure upon the hot and weary traveler. It has probably never occurred to him that the little building at the top of the hill may have something to do with the sanitary quality of the water. Just such springs, however, are notorious sources of typhoid fever.

Last year the engineer attached to the health unit of a certain county in a resort area made a survey of the facilities for excreta disposal at cottages, lodges, and camps, maintained for the accommodation of tourists. While the tourist bureaus for the section in question are busily extolling the virtues of its resort centers as a haven for those in search of health, let us examine the cold figures from the sanitary engineer's survey, given in Table I.

Table I. Number of Field Investigations and Sanitary Aspects of the Water Supplies and Excreta Disposal at Various Resorts, Tourist Camps, and so Forth

	Number Visited	Water Supplies			Excreta Disposal			
					Privies		Water Carriage	
		Approved	Unapproved	None	Bad	Fair	Systems	None
Resorts	87	18	51	18	19	67	1	0
Tourist camps	22	3	16	3	4	17	1	0
Taverns	123	5	97	21	53	48	18	4
Stores	75	3	64	8	25	39	10	1
Private camps	14	1	13	0	2	8	4	0
Hotels, cafés	16	0	10	6	7	5	4	0
Service stations	7	1	6	0	2	3	1	1
Totals	344	31	257	56	112	187	39	6
Percentages		9%	75%	16%	33%	54%	12%	1%

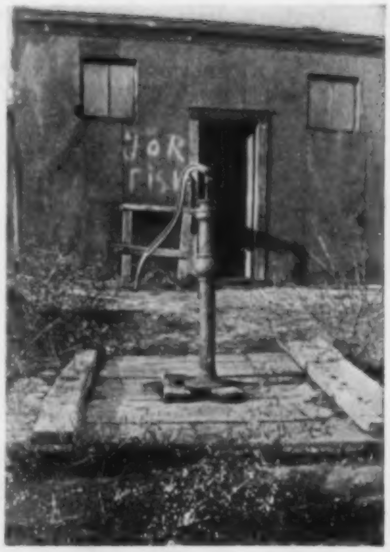
The survey brings out some astonishing facts. Of the total number of places included in it, only 9 per cent had an approved water supply; 75 per cent had a water supply that could not be approved; and 16 per cent had none. On the approved list were 18 out of 87 resorts; 3 out of 22 tourist camps; 5 out of 123 taverns; 3 out of 75 stores; 1 out of 14 private camps; none of the 16 hotels and cafés; and 1 out of 7 service stations.

The situation with respect to excreta disposal is fully as bad. Only 12 per cent of the places had flush toilets. Eighty-seven per cent were served by privies, of which 33 per cent were rated as bad and 54 per cent as fair. There were 4 taverns, 1 store, and 1 service station having no facilities of any kind for excreta disposal.

Draining a Mosquito Breeding Place

The Anopheles Mosquito, Which Transmits Malaria, Is a Serious Menace to Health in Many Parts of the United States

It is obvious from this survey that there is much to be desired in the way of sanitation at places catering to the wants of the traveling public. In a few cases a considerable expenditure would be necessary to remedy the defect but the majority of resorts, taverns, and roadside camps would need to expend but little time, money, or energy to put themselves in the approved class. Great sums have been expended in popularizing this county. All this might be wiped out at one sweep by an epidemic such as could arise from improper sanitation.



Customers in a Nearby Restaurant Must Drink the Water from This Pump

Such a Dug Well, Covered by a Loose Platform, May Become Seriously Contaminated by Surface Drainage

The conditions revealed by the survey must be regarded as representing a cross-section of the upper strata of resort areas generally; despite the much-heralded healthfulness of this region, the potentialities for the spread of typhoid fever and intestinal disorders are abundant. If these conditions were known, many travelers might decide to remain at home or go elsewhere.

DOES THE TRAILER PRESENT A HEALTH PROBLEM?

A great deal of interest is being focused on the trailer as presenting a migratory health problem. The average observer seems to believe that it is a serious menace as a disseminator of infectious material along the highways. It should be borne in mind, however, that the trailer is not occupied except at night and at stop-over stations. The occupants ordinarily make use of wayside comfort stations just as if there were no trailer attached to the car. Camp is commonly made at or near a tourist camp where such utilities as electric current, water, and toilet facilities can be had. Otherwise camp is most likely to be made in some sequestered spot well removed from human habitations. At most, the danger from trailers in transit could be no greater than that from railroad passenger cars strewing the right-of-way with raw fecal matter throughout the length and breadth of the country.

A certain amount of controversy is waged around the adequacy of the toilet equipment in the trailer itself. There has been no uniformity of design. In fact, trailers are being marketed without any toilet equipment at all. In the light of the foregoing observations relative to the trailer in transit, and in view of the fact that when its occupants reach their destination they naturally seek a location where the usual utilities will be accessible, it does not appear to be a matter of particular concern whether a trailer possesses toilet facilities or not.

The most serious sanitary menace arises when the trailer comes to rest. No stop-over lasting more than 24 hours should be permitted except in a properly equipped and licensed camp colony. It then becomes the job of the local health department, first, to require camp colonies to meet certain standards of sanitary equipment and maintenance; second, if necessary, to

force trailer squatters to concentrate in approved trailer camps; and third, to make frequent periodic inspections to insure faithful compliance with all the health regulations applicable to such a community.

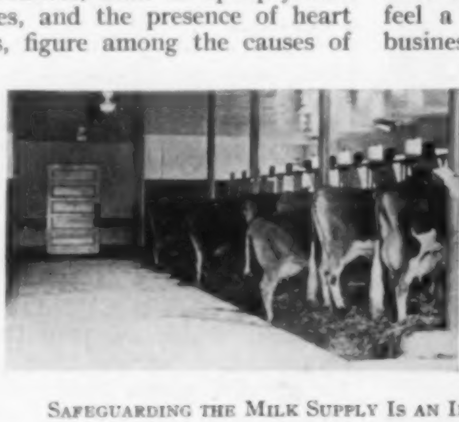
YELLOW FEVER AND AIRPLANE TRAVEL

In considering the various modes of travel, the airplane must not be overlooked. It so happens that airplane traffic has brought about a very acute problem in our international relations. We have long felt secure from the danger of invasion by yellow fever. The airplane has nullified this security. In certain Central and South American countries, there are known endemic foci of yellow fever within 24 hours' flight by plane. It is easily possible to import by plane *Aedes aegypti* mosquitoes infected with this disease. In the absence of mosquitoes capable of transmitting yellow fever, there would be no further spread of the disease. But where *Aedes aegypti* mosquitoes prevail, the presence of a yellow fever case, either imported from a foreign country or caused by mosquitoes so imported, might furnish the basis for an epidemic of incalculable seriousness.

THIS TYPE OF PRIVY, WHICH IS ALL TOO COMMON, MAY LEAD TO CONTAMINATION OF WATER AND FOOD SUPPLIES

MODERN SANITARY PRIVY, WHICH PROVIDES A PRACTICAL SOLUTION TO THE PROBLEM IN UNSEWERED AREAS

Everyone is familiar with the persistently high toll of death, disability, and damage due to highway accidents. Among the many factors responsible, one of the most important is the physical and mental condition of the driver. Unless he is in full possession of his faculties at all times, and his reaction time is normal, serious consequences may result. Defective eyesight, including subnormal visual acuity and restricted visual fields, should be the first to receive attention. The occurrence of periodic mental disturbances, such as epilepsy and certain common psychoses, and the presence of heart disease and neurosyphilis, figure among the causes of automobile accidents to a much greater extent than is ordinarily realized. These physical and mental states might well become the basis for regulations to be applied to motorists as a condition of licensure. If such regulations are adopted, certification as to physical and mental states should be made by a public agency rather than by a private physician. It would seem entirely logical to have this duty performed by local full-time health officers.



SAFEGUARDING THE MILK SUPPLY IS AN IMPORTANT FUNCTION OF THE LOCAL HEALTH SERVICE
From Dairy Barn to Pasteurizing Plant Close Vigilance Is Essential

NECESSITY FOR LOCAL HEALTH UNITS

Some of the health problems associated with travel can be effectively solved by state health forces. The "seal of safety" used in Ohio at roadside wells or city limits is a splendid example of this type of service. To a certain extent, also, state health departments can exercise control over food and its handling, and over hotel accommodations. The great majority of health safeguards for the traveling public, however, must depend upon local forces. This is especially true with respect to all acute communicable or contagious diseases. Sanitation of milk supplies is distinctly a local function, as are also the prevention of diseases transmitted by human excreta, the control of malaria and yellow fever, and the regulation of resort and trailer sanitation.

Experience has conclusively demonstrated that in the average state there is but one way of securing adequate health protection in these various fields. It cannot be done by health agents sent out at varying intervals by the state health department. The only solution is to establish competent local health services, commonly known as local health units, each serving a single county, or a district of two or more counties. The minimum field personnel required for such a unit consists of a medical director, a public health nurse, and a sanitary engineer or sanitarian. All should have technical training or satisfactory experience, or both, in their particular phases of the public health program, and all should devote their entire time to the work. There is no place for broken-down practitioners and politicians in local health service. The need is for keen and competent leaders to take up the work as a career service. It is this kind of organization and this type of work that must be relied upon to guarantee health safety to the unwary traveling public.

Through Title VI of the Social Security Act, a tremendous impetus has been given to the extension of competent full-time local health service. Funds allotted to the states from the Social Security appropriation are being used to a very large extent to assist counties and districts in financing local health units. Of the 3,000 counties in the United States, about 830 are at present equipped with full-time local health services. Not until all counties and cities are so equipped can the public feel a reasonable degree of security in traveling for business or pleasure.

Developments in Highway Transport

Forecasting Future Trends in the Design of Motor Vehicles and Arterial Highways

THREE aspects of modern highway-transportation trends, discussed at the Detroit Convention of the Society, are summarized in the accompanying articles. Two of the papers, those by Charles F. Kettering, M. Am. Soc. C.E., and Thomas H. MacDonald, were delivered before the general session on July 21, 1937, and the third, by Leroy C. Smith, Assoc. M. Am. Soc. C.E., before a session of the Highway Division on July 22, 1937.

No sweeping changes in motor-vehicle design, such as a switch from gasoline to Diesel engines or from front to rear location of power plants, are foreseen by Mr. Kettering. But steady advances in design and operating efficiency are sure to come, and these should be balanced by improved non-skidding surfaces and adequate lighting for highways.

The necessity for greater street and highway safety has become a national emergency, says Mr. MacDonald, due largely to present unsound practice in expending too large a share of highway funds upon the maintenance of poorly built local roads. The road of the future will be a multiple-lane highway, designed for high-speed through traffic and conceived as a link in a state-wide or nation-wide system.

Essential elements in carrying out a plan for the construction of adequate trunk-line highways in metropolitan areas are discussed by Mr. Smith in the third paper of the group. In the experience of Detroit, these elements are unanimous adoption of the plan, legislation enforcing it on property subdividers, adequate condemnation legislation, and conservation of automobile taxes for highway uses.

Motor Vehicles and Highways of the Future

BEFORE PREPARING his paper on motor vehicles and highways of the future, Charles F. Kettering, M. Am. Soc. C.E., vice-president of the General Motors Corporation and general manager of its Research Laboratories Division, sent a list of questions to a large group including more than a score of leaders among the manufacturers of automobiles and of products used in automobile construction and operation.

These questions involved factors which it was believed might affect road requirements for safer highway transportation over the next ten to twenty-five years. They included predictions on population trends; on the growth in registration, use, and speed of passenger cars, trucks, and buses; on changes in tires, mechanical safety devices, size and weight, character of fuel, lighting, and general design of motor vehicles; on the development of the trailer with its resulting problems; on laws regulating motor-vehicle operation and parking; and on future possibilities in type, kind, number, location, and construction of highways,. The returns to this questionnaire were interpreted by Mr. Kettering and given added force by his own keen observation.

Curves of the growth of population and number of motor vehicles in use indicate that our roads must accommodate 50 per cent more motor vehicles within the next 23 years. Complete elimination of parking in city streets does not appear practicable, but city-operated parking lots, residential grass plots, and office-building garages would provide partial remedies for existing conditions.

Although speeds of passenger cars may increase progressively with the years, it appears that the average driver today does not want to go much over 60 miles per hr, but wants to go that fast without effort. It also appears that any passenger car will be able to negotiate a 10-per cent grade without losing speed. There is little more that can be done with tires to give higher frictional coefficients for greater safety in braking, so that friction characteristics should be an important consideration in road construction. (At present brakes are designed on the basis of a frictional coefficient between tire and road of not more than 0.6.) It is probable that the present size of cars will not change to any great extent, and that road clearances will not be reduced much below the present figure of 8 in., but lower door clearances are here to stay and must be taken into account in constructing curbs.

There are a number of excellent reasons why cars designed with their engines in the rear would be desirable, but there is one difficulty which at present seems difficult to overcome. In order to insure proper maneuverability, which depends upon almost equal distribution of weight on front and rear wheels, a rear-engined car of reasonable wheel-base would require an engine of about half the weight of the present automobile power plant.

Tires now run from 20,000 to 30,000 miles. One place where tires can be greatly improved, however, is in blowout resistance. The trend in tire development is now towards improvements in compounding technique that will result in more heat-resisting rubber compounds, and a new tire now on the market uses a strong rayon cord which maintains its strength at high temperatures.

Mechanical devices which might be installed on roads to stop cars automatically include photo-electric cells

AN EXAMPLE OF MOTOR-TRAFFIC CONGESTION ON A CITY STREET

AT LEAST 100,000 TRAILERS WILL BE PRODUCED IN 1937

and relays, but expense and difficulty in enforcement constitute serious objections. Governors on cars have been called for in the past, but the public will not agree to limiting speeds to less than 50 miles per hr. Furthermore, the average speed on good roads today is less than 45 miles and city accidents occur at much less than this figure, so that the value of the governor is questionable.

All authorities agree that the perils of night driving are chiefly due to lack of adequate lighting and to glaring headlights. The future should bring a marked improvement in these conditions, through both road and vehicle lighting. The new sodium-vapor lamps are said to give nearly three times as much illumination as the best tungsten lamps, and the future will certainly see vast improvements in producing light at small power consumption. The use of polarized light to prevent glare has received wide attention, but although efficient, its production requires four to eight times the candlepower of present light systems to give the same visibility. Another system uses colored lights, such as blue and orange-red, with viewing screens which partially shut off the oncoming lights. Under this system cars traveling north and east, for example, would use blue lights and blue screens, while those traveling south and west would use orange-red lights and screens. Allied problems are road color and brightness, and visibility from the driver's seat.

A great increase in the use of trucks and buses is to be expected. Buses are already replacing street cars in the smaller cities (the critical population being between 100,000 and 200,000). In 1922 only 18 cities used buses exclusively; today there are over 420. Aluminum and pressed steel have reduced the weight of one large bus by 6,000 lb, with an actual increase in structural strength. Trucks will not drive the railroads out of business, however. Where it is believed desirable to separate trucks from passenger cars, new highways should be for the latter on account of the location of existing industries and business places. Diesel engines will soon be common in large trucks and buses, but are not suitable where mileages are low because of their high first cost. Moreover, a successful Diesel engine has never been built as small as automobile cylinder sizes.

There are probably several hundred thousand trailers on the roads today, and at least 100,000 more will be produced in 1937. There are now several designs of expandable trailers which visualize a working population housed in these 3- or 4-room movable bungalows. It is estimated that 80 to 85 per cent of trailers are now bought by working men for permanent homes. Already the trailer is used as a traveling display room for commercial products, and this development may have far-reaching results. The trailer brings with it engineering problems of water supply, power outlets, and sanitation, in addition to the question of parking camps and parks.

Turning finally to highway problems, Mr. Kettering emphasized the evils of road-tax diversion and called for a 50,000- or 60,000-mile primary system of high-speed highways crossing the country in all directions, consisting of limited-access freeways of the most modern design and construction.

The Trend of Modern Highways

CHANGES in highway utilization and improvement, while relatively slow in taking place, are nevertheless surely in progress, according to Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, whose paper on the trend of modern highways was read by Charles D. Curtiss, M. Am. Soc. C.E., secretary of the executive committee of the Highway Division. The most serious loss in highway investment in the past decade has been obsolescence resulting from changes in the number and speed of motor vehicles, and the necessity for greater street and highway safety has become a national emergency.

The revenues from special motor-vehicle taxes have been increasing over a long period, but because of large diversions to other purposes and because maintenance mileage has been constantly increasing, the funds available for new construction are dwindling in a number of states. Out of this situation have come the state-wide highway planning surveys now being carried on in 44 states and in Hawaii, designed to provide a factual basis for the complete administration of all highways.

Highway transportation by motor vehicle has proved to be the first great decentralizing transportation agency, water and rail transportation having tended to concentrate large populations in small areas. The decentralizing influence of motor-vehicle traffic is evidenced by the formation of wide bands of suburban development around cities. Another example is the breakdown of over-sized industrial units into units which are smaller but yet sufficiently large to retain the economies of mass production while affording a more healthful and desirable mode of life for workers and their families.

DIVIDED TRAFFIC LANES CONTRIBUTE TO SAFETY IN NEW JERSEY

Scientific planning of highways and highway systems of state-wide and nation-wide dimensions will be the most characteristic trend in future highway development. By placing highway administration on a sound economic engineering basis, scientific surveys and studies will reverse the present trend in many states, where the maintenance of poorly built local roads is absorbing too large a share of highway funds. Out of such studies will come classification of highways in accordance with

NORTHBORO GRADE SEPARATION ON THE BOSTON-WORCESTER TURNPIKE IN MASSACHUSETTS

the service they will perform and determination of the best type of design details for each group, fixing such factors as degree of curvature, minimum sight distance, number and widths of traffic lanes, shoulder widths, and divided roadways for multiple-lane highways.

In the field of highway design, the most important single development is soil stabilization. Present knowledge and methods of this subject permit scientific design of foundations as well as subgrades. Roadway design has come to embrace the entire right of way, and the trend is to landscape the roadsides, to provide sidewalks, footpaths, and bridle paths, and to protect against the erosion of soil.

Grade-crossing elimination has become a fixed policy which will continue until all important highway-railway grade crossings have been eliminated and the minor ones protected by adequate devices. This same policy is being rapidly extended to separation of important highways at intersections. In this connection it should be borne in mind that the widespread use of stop-and-go lights is not a solution for traffic problems but rather a product of necessity on overcrowded highways. In future, principal arteries in congested areas must permit a continuous flow of traffic through both cities and suburbs.

"Super-highways," or multiple-lane highways designed for high-speed through traffic, will probably be developed in the future, but only in the vicinity of our metropolitan areas. The 4,500-mile system of German super-highways is being built on wholly new rights of way with little or no access from abutting lands. Grade separations are universal, roadways are separated by parking strips, alignments are exceptionally good, and no modern design detail has been omitted. In France, where a system of national roads has been developed over a long period, present construction is designed to provide for traffic around the metropolitan districts (particularly near Paris) by a system of circumferential and radial roads. Here the detail of outstanding importance is the separation of cross-traffic.

In this country we are proceeding on the principle that the utilization of super-highways must produce directly the revenues with which to finance their construction, and as long as this method of financing is followed, super-highways will be integrated with the population centers rather than laid out on a transcontinental basis. They will also be developed to connect metropolitan areas which are separated by relatively short distances. It is logical to suppose that there will be further developments such as the Blue Ridge Parkway now under construction to connect the Shenandoah and the Great Smoky Mountain national parks, which recognizes the extensive use of motor vehicles for recreational purposes.

In closing, Mr. MacDonald emphasized the thought that we have completed the pioneer stage of road development. The power of highway improvement to accelerate the shift of population from areas of low-productive potential to more favorable areas will be consciously used hereafter in national policies for an attack upon land-use problems. A definite start, already being made in this direction, will become more apparent in the layout of the system of secondary or feeder roads.

Trunk-Line Highways in Metropolitan Areas

A CONDITION of uncertainty would exist in the attempt to provide trunk-line highways for metropolitan areas, said Leroy C. Smith, Assoc. M. Am. Soc. C.E., chief engineer of the Wayne County Road Commission, were it not for the salient fact that rights of way may be acquired immediately and actual pavement construction left to follow as the need develops.

The first step in a metropolitan trunk-line plan is therefore the selection of rights of way wide enough for ultimate development. The proposed highways will include (1) arterial highways radiating from the city; (2) traffic headers, or trunk-line loops, which will serve one or more of the following purposes: Provide by-passes for through traffic around congested areas, distribute traffic to and from arterial highways, relieve arterial highways at times of peak loading, or act as cross-town arteries for local traffic; (3) boulevards and parkways for recreational purposes; (4) secondary highways which act as major local streets; (5) highways designed for ultimate mass transportation; (6) express roadways with separated opposite-direction free-traffic lanes; (7) highways which provide space for public utilities (subways, etc.); (8) super-highways with facilities both for mass transportation and for local service, having grade separations and provision for interchange at every major intersection; and (9) double-decked streets in which the entire right of way on two levels is used. It is a moot point whether or not parking facilities should also be provided on highways.

Width of right of way is an important matter. For trunk-line highways in the Detroit area, a minimum width of 120 ft is provided. Secondary highways have a minimum width of right of way of 86 ft, and super-highways, 204 ft. For boulevards, a right of way of 150 ft is a practical minimum. Parkway rights of way should not be less than 200 ft in width.

The master plan for the metropolitan area of Detroit, adopted by the authorities controlling metropolitan streets and roads in 1925, dealt primarily with conditions

within a 15-mile circle from the city hall. The six super-highways called for in that plan have been made 204 ft wide within the 15-mile circle and 120 ft wide for many miles beyond that limit, surpassing their planned dimensions. These six highways are Fort Street, Michigan Avenue, Grand River Avenue, Northwestern Highway, Woodward Avenue, and Gratiot Avenue. Over 80 per cent of the 204-ft rights of way for these highways have been secured. In addition, double pavement sufficient for present needs has been built on these radial arteries and on seven other super-highways. The latter are the Base Line, Mound, Kelly, Stephenson, Southfield, Schoolcraft, and Telegraph roads. Furthermore, 38 of the 42 miles of the Outer Drive have been developed as a boulevard on a 150-ft right of way, and many of the 120-ft trunk-line highways and several parks and parkways have been developed.

A MODIFIED CLOVER-LEAF SUPER-HIGHWAY GRADE SEPARATION NEAR DETROIT, MICH.

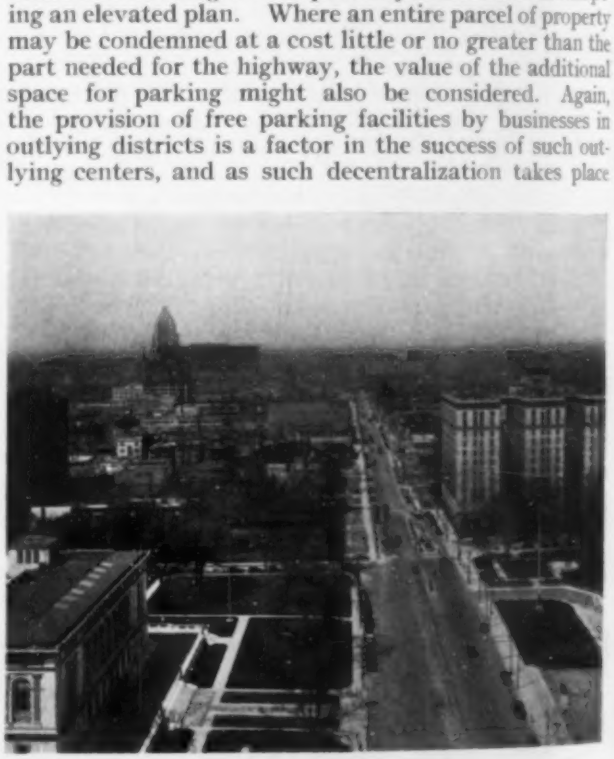
Telegraph Highway Appears in the Foreground. Base Line Highway, Consisting of Two 20-Ft Pavement Strips with a 104-Ft Reservation Centered on a 204-Ft Right of Way, Is Carried Over It on Two Bridges

The entire original master plan is thus almost a reality today in so far as ultimate right-of-way widths are concerned. This progress has been attained on a pay-as-you-go basis without issuance of bonds, as a result of unanimous adoption of the plan, legislation enforcing the plan on property subdividers, adequate condemnation legislation, and conservation of automobile taxes for highway uses.

A supplementary plan adopted in principle by the County Board of Supervisors calls for the widening of 61 miles of unimportant streets through the less prosperous part of the city, to provide 204-ft thoroughfares which will later be connected to form a loop approximately one mile square. It is believed advisable in this connection to take property on one rather than on both sides of the street. With an existing street width of 66 ft, the depth of the average lot and width of the average alley produce additional widths of 100 ft and 20 ft, respectively. Condemnation of an additional strip of 18 ft from the next (and cheaper) series of lots will thus produce the desired 204-ft right of way.

Rapid transit by express highway or by rail, to be effective, must be above or below grade, and local needs must be met at grade. It is believed that 204-ft rights of way are wide enough to provide adequate facilities for both express-highway and rail transit, and in cases where these facilities are on an elevated structure the area below will be available for parking space as well as for street-car operation. In this plan, as in others, complete grade separation, and facilities for local interchange of traffic would be provided at intersections. Another plan for freeways in congested districts contemplates using, for single-direction elevated expressways, 20-ft alleys at the rears of properties, together with 8 or 13 ft of air rights on each side, giving space for 30-ft or 40-ft cartways, respectively. Still another scheme would utilize the air rights over railroad rights of way to provide space for industrial expressways, but inelasticity in expanding railway facilities and the necessity for partial or complete electrification of railroad terminals constitute very serious objections. In general it is better to build elevated rather than subsurface structures on account of the saving both in first cost and in cost of alterations (if necessary).

It is difficult to foresee what the future will demand in the way of parking facilities as highway adjuncts. It should be borne in mind that the automobile owner now pays the cost of parking on highways as well as in covered parking areas and in open lots. Perhaps the cost of parking would be less if it were planned to be included in the highway system, and if areas at grade below elevated structures in congested districts were so utilized their value therefor might be a partial justification for adopting an elevated plan. Where an entire parcel of property may be condemned at a cost little or no greater than the part needed for the highway, the value of the additional space for parking might also be considered. Again, the provision of free parking facilities by businesses in outlying districts is a factor in the success of such outlying centers, and as such decentralization takes place



WOODWARD AVENUE, DETROIT, LOOKING NORTH FROM ART CENTER

The Right of Way Has Been Widened to 120 Ft., Buildings Removed or Moved Back, and a 90-Ft Pavement Constructed

largely at the expense of existing businesses in central districts, consideration should be given to providing parking facilities therein.

In conclusion, Mr. Smith pointed out that adequate legislation is necessary to make plans for a trunk-line system effective and reviewed Michigan legislation found useful in effectuating the plan for the Detroit metropolitan area.

Highway Finances and Express Roads

Solutions for Some Problems Arising from Recent Traffic Developments

INCREASE in volume and speed of motor traffic in recent years has introduced new problems in financing and constructing modern highways. Two papers dealing with these problems were presented at the Detroit Convention of the Society, the first aspect being discussed by Murray D. Van Wagoner before the general session on July 21, 1937, and the second by John S. Crandell, M. Am. Soc. C.E., before the Highway Division on July 22. Abstracts of both addresses are presented herewith.

Although trunk-line highways carry more than 60 per cent of rural motor traffic in Michigan, Mr. Van Wagoner points out that they receive less than 40 per cent of rural motor-vehicle revenues, the remainder being applied to county and local roads. This unbalanced condition has greatly hampered the development of an adequate system for present and future needs, and a very obvious remedy lies in the allocation of revenues on the basis of counted vehicle-miles. The article is particularly timely since similar conditions prevail in many states besides Michigan.

The second article emphasizes advantages of the express highway in terms of time-saving, convenience, and safety. After describing the engineering features of the high-speed highways which have been built by Italy and Germany for possible military as well as economic purposes, Professor Crandell lists a number of reasons why he believes a country-wide express-highway system should be constructed in the United States, with federal funds if necessary.

Highway Traffic and Motor-Vehicle Taxation

By Murray D. Van Wagoner

State Highway Commissioner of Michigan, Lansing, Mich.

As a public utility, a highway system closely resembles an electric-power supply system in that both deliver a service which the consumer utilizes for the operation of his own apparatus. But while the electric meter measures the amount of current used, the highway meter, as represented by the motor-vehicle tax system, measures only the consumer's use of his own apparatus. This circumstance has permitted the essential balance between payment for and benefit from highway service to fall out of adjustment.

Fortunately, a large number of states, of which Michigan is one, are conducting highway planning surveys which include very detailed and thorough-going studies of traffic. It is believed that the results of these surveys will form an excellent basis for readjustment and correction of the existing unbalanced conditions.

MEASURING HIGHWAY TRAFFIC

Highway traffic is measured in vehicle-miles, or the sum of the miles traveled by every vehicle using the highway or highways during a designated period of time. An actual count of the vehicle-miles has been made on rural highways and on the streets of Detroit.

It is probable that the total traffic on all Michigan highways and streets amounts to about 10.5 billion vehicle-miles annually. These ten billion vehicle-miles were produced by a state with a population of 4.8 millions, which owns automobiles in the ratio of one car to every 3.9 persons.

But neither population nor car-ownership is spread evenly throughout the state, as more than 38 per cent of the population is concentrated in one county, while the ratio of persons to car varies from 3.81 in the dominantly agricultural counties of the southern lower peninsula to 5.75 in the western upper peninsula. Rural residents of the western upper peninsula own one automobile to 8 people, while the residents of the small urban communities in the southern agricultural counties of the lower peninsula own one car to 2.47 persons. For the state as a whole, the rural ratio is one to 5.5, and the urban ratio one to 3.5.

These differences are the reflection of wide variations in the character and development of the several parts of the state. Industrial activity is an important factor in the economic life of the whole southern third of the lower peninsula, but there is also a progressive and prosperous agricultural development in this area, which spreads farther north into the central part of the state. On the

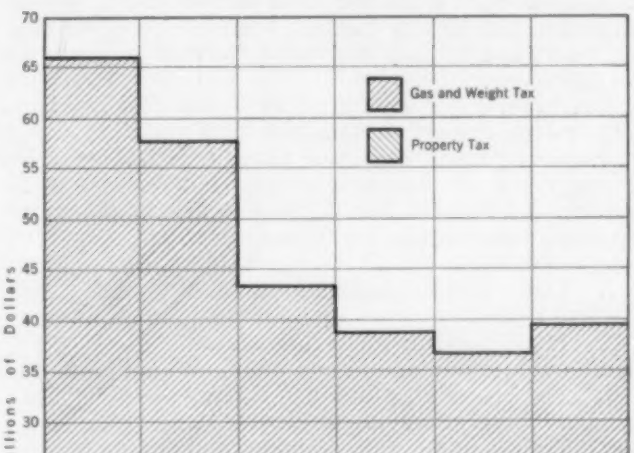


Fig. 1. Sources of Highway Revenue in Michigan

Showing How Michigan's Local Highways Swapped Horses in the Middle of the Depression Stream, from Local Taxpayers to Motor-Vehicle Owners

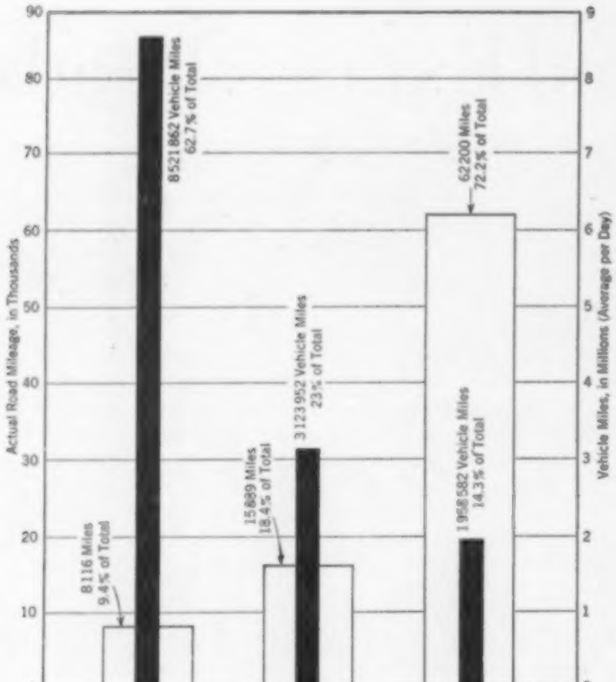


FIG. 2. MILEAGE OF THE THREE CLASSES OF MICHIGAN RURAL HIGHWAYS COMPARED WITH THEIR SERVICE TO TRAFFIC

The 9.4 Per Cent of Trunk-Line Highways Which Produce 62.7 Per Cent of Rural Vehicle-Miles Should Receive the Benefit of Taxes in Proportion to Their Use

other hand, the northern third of the lower peninsula and most of the upper peninsula lie in the backwash of a spent timber industry and a declining mining industry. Here agriculture is for the most part tentative and unprofitable, and smaller industries and a rapidly developing resort and tourist trade offer the best prospects for the future.

Naturally, if Michigan is to develop an adequate highway system, it must be based on these variations in the character of travel and must provide adequate service to every one of the state's component parts and interests. Such an efficient highway system must be built with due consideration for the following conditions:

1. The origins, destinations, and kinds of traffic.
2. The volume in which it uses each street and highway.
3. The speed at which its various elements travel under various conditions.
4. The planning of new routes to aid in the development of the state's natural resources.

It seems probable that the large proportion of recreational to total travel is not generally appreciated. No less an authority than Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has estimated that from 70 to 75 per cent of highway traffic is generated by the social and recreational motive, and observations made in Michigan tend to substantiate this estimate. In view of the apparent importance of this social recreational impulse, it seems advisable to investigate its characteristics. What is the range, for instance, of recreational travel among industrial employees in the metropolitan areas? How much does the rural resident use the rural, local, secondary and primary systems, and city streets? How much does the urban resident use the city streets, the rural, primary, secondary, and local systems? The answers to these questions, properly applied, will go a long way towards producing an adequate system of highways.

Certain inadequacies in our present highway system are shown up by the severe congestion that occurs under the normal peak loads of traffic on trunk-line highways and important city streets. Some part of the accident toll must be laid to the resulting conditions and to elements of design inherited from an earlier day, such as inadequate sight distances and insufficient superelevation. Another example of imperfect highway design is the lack of trunk-line highways. In addition, existing secondary highways and local roads are often handicapped by inadequate design, poor surfacing, and narrow bridges.

So much for the highway system as it is related to present traffic conditions. What can be foretold of the future traffic which it must serve? It seems certain that traffic volume will continue to increase, but it is probable that the dominant factor in this growth will not be increase in number of registrations, as in the past, but rather greater use of the individual automobile and enlargement of its radius of travel. In any event, betterments and extensions of highway service are needed.

HIGHWAYS OF THE FUTURE

Trunk-line highways will be located to afford the shortest practicable route between important points for the assembling and dispersion of fast through passenger and freight main-line traffic. They must be adequate to carry the traffic that will use them, and should be designed for higher speeds than the maximum at which comparable traffic travels today. Trunk-lines will be protected by grade separations, side-service roads, and by-pass routes through urban areas.

Secondary highways will generally be designed to serve a dual purpose—as auxiliaries to the trunk-line highways and as the main arteries for local travel in areas not directly traversed by main trunk-lines.

In the northern sections of the state, portions of trunk-

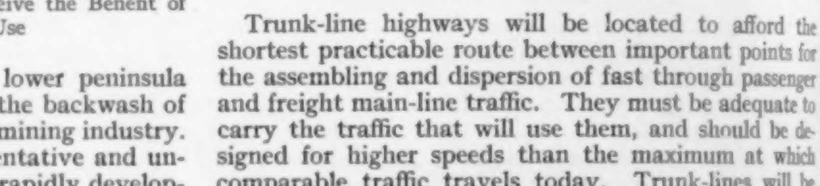


FIG. 3. DISTRIBUTION OF MOTOR-VEHICLE REVENUES IN MICHIGAN

Note the Greatly Increased Amounts Returned to the Counties in Recent Years, and the Greatly Reduced Amounts Available to the State Highway Department for Construction

line highways have been relocated and several secondary highways have been built to give better access to the lakes and scenic countryside.

The secondary highways raise fewer problems than either the trunk-lines or the local roads. On the one hand, their traffic will rarely reach such proportions as to demand special facilities, while, on the other, it will seldom fall so low as to raise the question of economic utility. If there is any such thing as a "norm" in highway design and service, it is probable that the secondary road comes the nearest to representing it.

A SHORE-LINE SECTION OF U. S. ROUTE 2 BETWEEN ST. IGNACE AND MANISTIQUE
This Trunk-Line Highway Has Encouraged Recreational Travel in the Upper Peninsula

Local roads will continue as in the past to carry each unit of traffic to or from its place of ultimate destination or origin. They are equally important as the channels through which inhabitants of rural districts gain access to practically all public, social, and economic services.

The basic demand on such roads will be then, as now, certainty of service. This may be accepted as the minimum requirement of any road that has the right to exist. Where traffic demonstrates the need for improvement, recently developed methods of stabilization and modern low-cost surfaces will afford the means for economical development.

City streets will continue to provide for urban areas much the same services that secondary and local roads provide for rural districts. Such operations as the street-widening and grade-separation programs which, after several years' work, are still under way in Detroit, indicate the magnitude of the task of bringing some of these streets up to the standards we have set for the future.

AN OIL-AGGREGATE COUNTY ROAD
The Degree of Improvement of County and Local Roads Should Be Determined on the Basis of Their Use

MOTOR-VEHICLE REVENUES

In pre-automobile days, when the use of Michigan highways was largely local, the property tax was an approximately fair means of paying for a local and community service. But as the automobile gave impetus to the development of intersectional and state-wide highway systems, the broadened service was recognized in the participation, first of the state, and later of the federal government, in the costs.

As the burden on the general funds of the state became heavy it was natural that a method should have been sought for assessing the costs of trunk-line highways against automobile owners. First the weight tax was adopted and then the tax on gasoline. During the period from 1905 to 1930, appropriations from general funds, a bond issue, and (later) revenues from the two motor-vehicle taxes paid for the trunk-lines, while local levies continued to pay for roads whose service was still recognized as local in character. This dual system provided ample highway revenues in most parts of the state.

The depression broke this balance; a stringency developed in local finances in 1930, growing rapidly more intense. The hardest-hit of the smaller units as far as highway finances were concerned, were local road districts. In some cases these districts were loaded with a considerable burden of highway taxation but in others the debt burdens had been incurred in exploiting a current boom in land values. In Michigan, the relief of such situations was the starting point for a revolution in the financing of highways. By 1935, when the revolution was completed, the motor-vehicle revenues had become the principal source of support of all highways, and practically the sole support for rural highways. A few percentages will show what has happened.

In 1930, as shown in Fig. 1, motor-vehicle revenues made up only about 35 per cent of all highway funds raised in the state, but in 1935 the proportion had increased to 61 per cent. In the same period the contribution of property taxes to highways shrank from more than 57 to less than 22 per cent. Between 1930 and 1935 the property taxes in urban communities as a whole suffered a shrinkage of 50 per cent, but during the same period, in the rural sections of the state, a sweeping decline of 90 per cent practically ended local contributions for highway purposes. The process by which motor-vehicle revenues were thrown in to fill this gap consisted in transferring to the counties all the weight-tax revenues and \$6,550,000 of the gasoline-tax revenues. At the same time, the former township roads were merged with the county systems.

The full significance of this wholesale readjustment is manifest when a comparison is made of traffic volume and financial support. Although the county and local roads carry only a little more than 37 per cent of the vehicle-miles produced on rural highways, (Fig. 2), they are the situs of the expenditure of more than 60 per cent

DRIVE ALONG LAKE ST. CLAIR, NEAR DETROIT, MICH.
This Boulevard Type of Road Consists of Two 27-Ft Pavements, with a 22-Ft Landscaped Strip Between, Centered on a 120-Ft Right of Way

of the motor-vehicle revenues (Fig. 3). At the same time, the primary system which carries nearly 63 per cent of rural traffic, receives less than 40 per cent of these revenues. Furthermore, various deductions made from the share of the primary routes reduce the actual amount available for construction and maintenance of the system to less then 30 per cent of the total motor-vehicle revenues. When it is remembered that it is travel on the primary system which produces these revenues, fears for the future of highway development are fully justified.

Despite the fact that the Michigan legislature has recently made available from the general funds $5,000,000 additional for use on the state trunk-line system to partially replace the motor-vehicle revenues transferred to local units, there is vital need for a sound and permanent basis for the allotment of these revenues. A large expenditure will be required over a period of years to bring the various types of highways up to even a tolerable level of adequacy, and motor-vehicle revenues will be insufficient for this purpose if, as at present, they are dissipated over the entire road mileage of the state. Well-sustained highway service and fairness to automobile owners demand that until the major roads are adequately improved, the bulk of motor-vehicle revenues should be devoted to those highways which carry the bulk of the traffic.

PLANNING FAIR ALLOCATION OF REVENUES

Trunk-line and secondary highways must be determined on the basis of which best meets the requirements of all users, both urban and rural, taking into account traffic volume and revenue production. Once determined, these highways should be improved as rapidly as possible with practically the full resources of the motor-vehicle taxes.

Such a determination will necessarily exclude a considerable mileage of streets and roads. If any motor-vehicle revenue at all is allotted to these local streets and roads, it should not be greatly in excess of the amount they generate. Some form of general tax should pay the bill for any further needed improvements on them. The improvement of urban streets with motor-vehicle funds should not take place until trunk-line arteries in and near cities are completed.

Highway planning, however, is not a mere matter of allocating revenues on the basis of counted vehicle-miles. The development of the recreational, agricultural, or other resources of certain areas may depend upon the provision of adequate highways, and such factors must also be given weight in the determination of where highways are to be improved or extended.

The broader and more fundamental function of trunk-line and secondary highways can only be fulfilled if expenditures for their improvement and support are brought into line with their service to traffic and their contributions to highway revenue. That policy, if it is based on sound facts and unbiased judgment, can be firmly established as the corner-stone of the highway of the future and as the auto-owner's bill of rights.

The Express Road and the Highway System

By JOHN S. CRANDELL
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PROFESSOR, HIGHWAY ENGINEERING, UNIVERSITY OF ILLINOIS, URBANA, ILL.

AS far as I know, the first attempt to build what may be termed a modern highway in America was the Grand Boulevard and Concourse in the borough of the Bronx, New York, N. Y. It was designed at the beginning of this century with a total width of 182 ft, and completed (for the time being) about 1907. It consisted of sidewalks along both edges, a carriageway adjoining each sidewalk with a grass plot between, a grass plot planted with trees and shrubs on the inner sides of the carriageways, and a center section of considerable width designed for fast horses. High fills were made use of to keep the grades almost negligible. Since these fills would have made, and in many cases do make, dead-end streets, the principal cross-roads pass under the boulevard, and on the whole, the concourse was almost a "limited" way.

About the time that the concourse was finished, the days of the trotting horse were over. For many years the center roadway of 66 ft remained an earth road, where thousands of Bronx babies were wheeled about in

their perambulators. The motor vehicle had taken over the side lanes, which were of macadam, surface-treated with tar, and the land back of the building lines was still in truck gardens. Then almost overnight the limited way changed to an unlimited thoroughfare; the center roadway was paved with sheet asphalt; and tremendous hordes of motor cars passed in both directions all day and all night.

This brief history of the concourse has been presented because it goes to show what may be the story of other boulevards and express highways. Arthur W. Dean, M. Am. Soc. C.E., in a recent article in *Engineering News-Record* (Vol. 118, No. 25) suggests a "sufficient set-back of all buildings along a through highway, so that an area will be left beside the road of sufficient depth and length to permit vehicles to leave the main highway at almost their usual speed and have room to slow down within the parking space at one side." By this means he would refrain from prohibiting business entering along such roads, but would attempt to assure the safety of drivers using the highway.

View of the Fort Super-Highway in Detroit
The Viaduct Over the Railroads Is 100 Ft Wide and Carries an 80-Ft Pavement

VALUE OF THE EXPRESS HIGHWAY

Express routes should skirt the edges of intensive development. Yet, as Mr. Dean correctly observes, it is not long before intensive development skirts the edges of the express highway. What can we do about it? What have other nations done? These and other questions are of more than passing interest to us. We are about to spend large sums of money on such schemes, and we would like to know whether or not they will benefit us and our progeny.

Some years ago my office was located in New York City at the lowest tip of Manhattan Island. Occasionally I would ride uptown to 42nd Street with a colleague who frequently drove to and from the office. The time required never was less than 45 minutes, and often was over an hour, yet the distance is less than four miles. Since those days the elevated express highway has been built along West Street. Last year I traversed the same distance, at the same hour of the day, in nine minutes. Furthermore, I was not a nervous wreck when I reached 42nd Street, as I had invariably been on previous occasions.

I used to attempt to drive to Philadelphia from downtown New York. The time consumed in reaching Newark via the Hudson River ferry and the regular highway route was once two hours and seven minutes, although the distance is only about 12 miles. Now, with the express highway via the Holland Tunnel, and the elevated highway across the New Jersey meadows, the time required for such a trip is about 20 minutes.

It must be remembered that these express highways are elevated structures along which it is not possible for commerce to force its way. There are ramps to and from the elevated highway to the roadways beneath, and if the motorist wishes to buy a stamp or a drink he must leave the express highway and make his purchases elsewhere. But the average thinking man feels certain that the express highway will serve him better than any other type he has ever heard of. He knows that the express train is faster and more comfortable than the local, and he would like an opportunity to drive on a roadway where there are no intersections at grade, where he may "hit it up" if he wants to, and where he will be unusually safe.

But where, you may ask, should the express highway be built? Who can and who should pay for it? Should it be an express toll road, or should it be free? If the small town needs one and cannot afford to pay for it, should the state or the federal government be forced to shoulder the cost? These are difficult questions to answer. Perhaps we can get a better perspective if we journey overseas to find out what other nations are doing.

THE ITALIAN AUTOSTRADE

The American tourist who takes his car to Italy is immediately impressed with the general excellence of the road system, and he is overjoyed to travel on the very modern *autostrade* (roads for fast motor-traffic only) of which he will find nearly three hundred miles. For the most part, toll is charged on these roads, amounting to about a cent a mile. Motor traffic only is allowed on the *autostrada*, which is really an express highway, and is constructed very much like a railroad. Land is acquired by purchase. As a rule each *autostrada* is given in concession to a private concern which receives assistance from the government and from interested organizations. There are no grade crossings with highways or railroads on the *autostrade*.

Quoting from my article, "A Touring Engineer's Impressions of the Roads of Italy" (*Engineering News-Record*, November 14, 1935), "The *autostrade* very much resemble the drives of the Westchester County Park system, New York. The pavement is from $26^1/_2$ to 33 ft wide, in general, although the Milan-to-the-Lakes *autostrada* is 46 ft wide. Grades are usually less than 3 per

cent. Vertical curves provide adequate sight distance even at very high speeds. Alinement is excellent. . . . Connection is made with other through routes at important intersections, but the *autostrade* enter no cities or towns directly."

This description gives an idea of what Italy has been doing in the past ten years, for the work began in 1928.

account of the international highway across Europe (CIVIL ENGINEERING for February 1937). But Germany is building far more than this one highway. In fact, she is at work on a network of 4,375 miles of express highways, and when these are finished it will be found that all parts of the Reich are connected by a new system of high-speed roads designed for a maximum of 112 mph.

Showing the Docks and Traffic Incidental to Shipping, with the Boulevard in the Background

Showing Ramps and Stairs to the Boulevard. Heavy Trucks Are Not Allowed on the Boulevard

WATERFRONT SCENES IN ALGIERS, PORT OF FRANCE

"Bridges carrying traffic over the *autostrade* are generally of sufficient span to permit of the *autostrade* pavements being widened when necessary. . . .Tunnels are not uncommon on some of the routes. . . .The pavements are either portland-cement concrete about 8 in. thick, or asphaltic concrete on a Telford base. . . .There is usually a grass or a gravel shoulder about 3 ft wide on either side of the pavement."

On these *autostrade* there is no speed limit. There really need be none, for traffic is light, and the way is straight. There are, of course, chances of head-on collisions and side-swipes, for none of these highways is of the dual-lane type. But with the present traffic conditions and the width of the traveled way there is practically no danger.

It will be noted that Italy has let out these express highways as concessions to private companies. The length of life of these concessions is fifty years, after which the highways revert to the state. It is much the same as if our old toll-road companies had been compelled to turn over their roads in good condition to the various states after a half century of use. There are, however, three of these roads which are the property of Italy now, and on which there is no toll. These are short stretches.

There is also a truck highway in Italy, extending from Genoa to Serravalle and Scrivia. It was built so that there might be easy communication from the seacoast to the inland towns in the region of Genoa. It is 50 km long, has 11 tunnels and 30 bridges, and is wide enough for two lanes of trucks going in opposite directions with a central space for smaller vehicles. Please observe that neither the express highways nor the truck road is built with local capital. The small town is not charged for the benefits that come to it through the location of these highways.

EXPRESS HIGHWAYS IN GERMANY

Germany has not been far behind Italy in the construction of express highways. I had the opportunity in 1935 of visiting several hundred miles of these roads, both completed and under construction. Robert B. Brooks, M. Am. Soc. C.E., has written an interesting

These are dual-lane highways, with a parkway 5 m wide between the lanes. The lanes are each 7.5 m wide, and there are shoulders on each side 1 m wide. In some localities bicycle paths have been added, but they are for the most part motor-vehicle express highways. The bridges are huge, resembling railroad rather than highway structures. The pavements are, in general, portland-cement concrete 10 in. thick laid on a 12-in. macadam base. I am told that the 1937 type is not so thick, but I have no verification of this.

Quoting from my article on "German Superhighways" (*Engineering News-Record*, Vol. 117, No. 9), "Toll will not be charged at first, although motorists have been told that later on toll charges may be expected. The total cost will be about a billion dollars. . . .The new highway system and the national railroad system are under the same management. This was, perhaps a shrewd step forward, since it does away with jealousy and managerial warfare."

Care has been taken to preserve the natural beauties of the landscape. There are no grade crossings of any kind. These express highways do not enter the towns, but by-pass them. Grades are not to be over 5 per cent, except in a very few instances where steeper grades are encountered for short distances only. Curves are superelevated up to 6 per cent.

Land that is not in possession of the state is bought at market value for these roads. A special company controlled by the government will supply all the filling stations on the new roads, turning in its profits to the state. The work is being financed by taking up credits and by using the doles which would have been paid to the unemployed. These doles amount to 35 per cent of the money spent. Again, as in Italy, the towns abutting on the express highways are not taxed for the benefits they obtain.

Essentially these express highways both in Italy and in Germany are military roads over which all forms of military transportation equipment can be rushed at unbelievable speed. A map of the country will show how strategically these highways have been placed.

What of the place of the express highway in a modern road system? We see that in two foreign countries the express highway is undoubtedly built for protection and

for aggression. Has this any bearing on our own case, or are we to build solely for peace purposes, if at all? Already we have built some short sections of express highways here and there, but no federal express-highway plan has been put into execution whereby the entire nation would be brought closer together.

I think that our large cities will and must construct express highways leading directly into them. If they do not, then they will be like the towns in the railroad era that lost business because they were only on a spur of the line. The improvement of this type which St. Louis is undertaking will bring added wealth to it. There are many other cities that would be improved by such highways. One has but to think of Pittsburgh, Milwaukee, Cincinnati, Boston, and a dozen others. Chicago has talked about such a project for years, but nothing has come of the talk yet.

Do we need military roads? With due deference to the pacifists, we do! Many will remember our troubles in 1917–1918 when we tried to use the highways to transport only a comparatively small number of empty trucks from Detroit to New York for overseas service. Today we are not so badly off, yet if we had a war and needed rapid transport of our resources we would find that our highways are hopelessly out of date as compared with those of either Germany or Italy. Express highways can serve the purposes of both peace and war. It is my opinion that our military advisers should push this project to its ultimate completion.

The present younger generation probably does not know the meaning of the word "preparedness" which was heard everywhere twenty years ago. Many of the older generation have forgotten all about it. I suggest that we all think of it, act on it, and really prepare highways on which troops and supplies can be carried in case of need.

This Beautiful Drive Skirts the Mediterranean

The Drive Resembles an Express Highway in Many Respects

Two Views of the Riviera Drive

ADDITIONAL ADVANTAGES OF EXPRESS ROUTES

Who is there who does not daily wish that he could drive his car on a roadway free from trucks and buses? The express highway would do away with such complaints from this source, because passenger cars and trucks would be segregated. It may be that in some forms of design, passenger cars only will be allowed and trucks and busses will be obliged to travel other routes. On other types of express highways there will be lanes set aside for the different classes of traffic.

We are using our highways today for rapid travel, and the business man who is driving to get somewhere quickly wants safe, easy driving on well-marked roads that will assure an early arrival at his destination. Express highways will serve his need; no other type is so satisfactory.

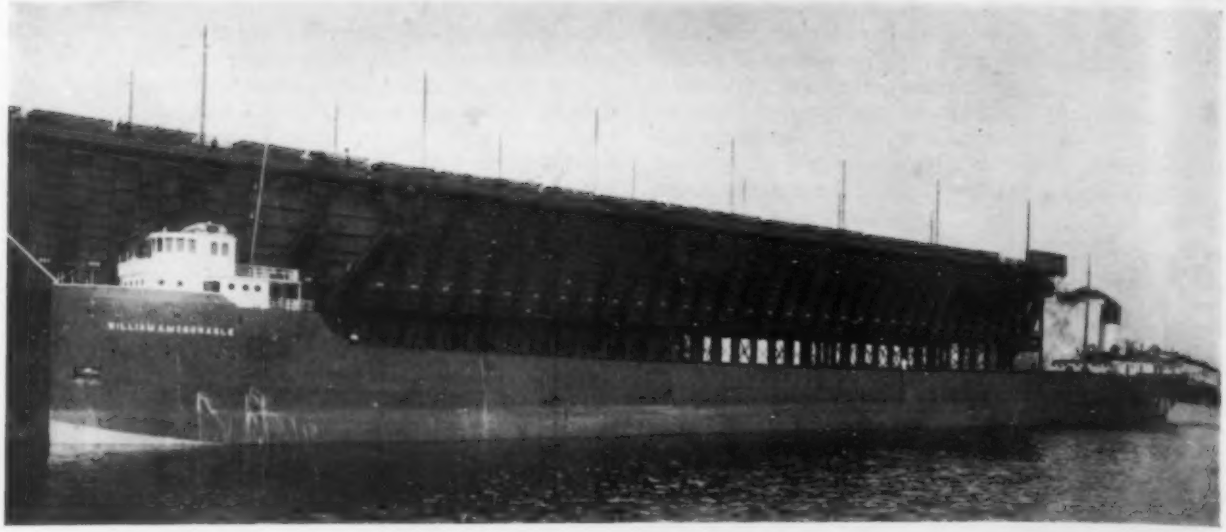
I believe that the up-to-date business man in this country no longer wants to force outside traffic through his town on the chance of making a sale or two. I say this in spite of the fact that I am living in a small town where a few of the business men think that any attempt to by-pass the town is a political deal. There will be some attempt made by these misguided individuals to defeat the express highway idea, but then we must expect opposition from the few; the others will help us put the scheme through.

We need express highways—not only close to our large cities, but also up and down and across our land. It is true that in the states west of the Mississippi, excluding California, there is not enough traffic to warrant the expense of such a scheme, but this does not mean that now is not the time to acquire land for the subsequent building of these roads when the need arises. In built-up sections of the country it is going to be costly to obtain a right of way sufficiently wide for a well-designed express highway, but the longer we wait the more expensive it will be. Also, the longer we wait the more expense is being incurred by the motorist.

Many centers of population in the East should be connected by adequate express highways. I suggest a line from Portland, Me., passing close to Boston, New London, New Haven, Bridgeport, New York, Newark, Trenton, Philadelphia, Wilmington, Baltimore, Washington, and Richmond, to Raleigh. Another should stretch westward from the New York region to Chicago, and on to Omaha. There should be yet another from Philadelphia and Washington through Pittsburgh and the Ohio River valley to St. Louis. Several more are needed around the New York, Philadelphia, Boston, and Washington regions in the East, and the Cleveland, Pittsburgh, Cincinnati, Chicago, Milwaukee, St. Louis, and similar regions in the Middle West. These are but the start.

Of course, it may be that by the time we have constructed these express highways we will no longer need them because all we will have to do at that time will be to press a button, and television will connect us immediately with our destination, so that we will not need to go anywhere. However, while we are waiting for such changes to take place, it would be well to start active construction of adequate express highways for our own day and age, with a look toward the future.

The express highway is worth all its legitimate cost if it is located with skill. It saves time, tempers, and lives. The longer we delay, the more expensive these highways will be.



ORE-LOADING DOCK AT DULUTH-SUPERIOR WHERE A FREIGHTER CAN BE LOADED IN TWENTY MINUTES OR LESS

Transportation on the Great Lakes

History and Present Status of a Major Inland Waterway

By M. C. TYLER

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IN a single year, more tonnage has passed through the canals between Lake Superior and Lake Huron than through Suez and Panama combined. This fact alone well illustrates the tremendous importance of the Great Lakes waterways in the industrial and commercial development of the United States. In the present article, General Tyler traces the history, and describes the present status, of Lake commerce. His original comprehensive paper, of which this is a brief summary, was given before the Waterways Division session at the 1937 Annual Convention of the Society.

WATER transportation on the Great Lakes and the St. Lawrence has had a tremendous influence on the political and economic history of the United States and Canada. It was only when Wolfe cut the root of French water transportation by the capture of Quebec in 1759 that "New France" became British territory. In the American Revolution, water transportation available to the British from Quebec and Montreal came near to causing us disaster. In 1813, had not control of the Lakes been regained after the first reverses, our great iron-ore deposits might have been lost to Canada. By 1830 the Erie and Welland canals were completed, and a daily boat line was running between Buffalo and Detroit. These transportation links greatly expedited the settlement of Michigan, Wisconsin, and northern Illinois.

Naturally, the early commerce on the Lakes was in grain and lumber, from the west, and in manufactured goods from the east. Soon, however, copper and silver began to be mined in the Lake Superior region, and in 1844 iron ore was discovered near Marquette. Through commerce from Lake Superior was blocked by the rapids in the St. Marys River until 1855, when the state of Michigan constructed a canal with locks at that point. Duluth and Superior quickly developed as supply points for lumbermen. In 1871 wheat began moving from Minnesota by lake, and rapidly thereafter these ports became the outlet for grain from that state and from North Dakota and Montana.

During the great era of railroad building that followed the Civil War, the demand for iron was met by the building of furnaces in the area between Lake Erie and the Monongahela, where ore by lake and coal by rail and river could be brought together quickly and cheaply. Later the same principle caused the development of the steel industry in northwestern Indiana. Meanwhile, the demand for coal in the upper Lake states was met by the fields of western Pennsylvania, West Virginia, Kentucky, and Ohio, from which the commodity was transported at low cost by a combined rail and water route.

Coming down to the years of the World War, we find the great system of Lake and rail transportation meeting every requirement of the emergency. As long as our iron mines on Lake Superior last, the transportation system built around water carriage on the Great Lakes will continue to be one of the greatest elements of our military strength.

CHANNELS AND HARBORS

In its original condition, each of the Great Lakes afforded easy navigation, but connecting channels were inadequate. The Welland Canal (1829) provided navigation between Lake Ontario and Lake Erie, and the first canal at Sault Ste. Marie (1855) connected Lakes Huron and Superior.

There were almost no natural harbors of commercial value along the American shores, so Congress early began to authorize the improvement of channels and the construction of harbors by the War Department. Among the earliest works may be mentioned those of Erie Harbor, begun in 1824; Lorain, Cleveland, and Buffalo (all before 1830); and Chicago, 1833. In this work the federal government limited itself to providing entrance channels; the municipalities and vessel operators took care of the channels inside the jetties.

By 1869 vessels had so increased in size and number that the need of outer breakwaters to afford anchorages was apparent. Timber cribs filled with stone were

standard construction for the earlier breakwaters, and most of them—now capped with concrete—are still in service.

From these modest beginnings, designed to meet immediate needs, steady progress has been made. At the present time the Lake system consists, in addition to adequate harbors, of down-bound connecting channels 25 ft or more in depth, from Duluth-Superior and from Chicago to Ogdensburg on the St. Lawrence (with 14-ft channels in the Canadian canals to Montreal), and up-bound channels 21 ft deep. The New York State Barge Canal and the Illinois Waterway are important connecting links to the east and south. The locks at the Soo (Sault Ste. Marie) and on the new Welland Canal can accommodate the largest boats in the Lake trade.

TYPES OF SHIPS IN USE ON LAKES

It has been impracticable to provide depths for Lake navigation equal to that at ocean ports. Channel and harbor depths have limited the draft of vessels; dock equipment has limited their beam; and safe handling in restricted waters has limited their length, although the moderate height of storm waves has permitted ratios of length to beam and to depth greater than in ocean practice. As a result of all these factors a bulk freighter has been developed with large rudder power, which can carry about as much on a 22-ft draft as large ocean vessels can carry on 30 ft or more.

Typical Lake bulk freighters have over-all lengths from 280 to 600 ft, and beams from 40 to 64 ft. Their carrying capacity on a 19-ft draft ranges from 3,000 to 12,000 short tons. They are usually constructed with the deck house and high bridges forward; a cargo hold, without bulkheads; and a coal-burning power plant aft.

Among other special types of vessel in use on the Lakes should be mentioned the self-unloaders, of which 65 were in operation in 1936. Most of these vessels are of the usual ore-and-cargo-handling types with cargo hoppers installed in their holds, discharging onto belt conveyors and through a bucket conveyor onto a belt conveyor carried on a long boom. Some of them can place their loads as far as 115 ft from the ship's side and at an elevation of 65 ft above deck level.

There are also several "automobile carriers," converted from bulk freighters by the addition of between-decks and elevators. One of these is a pioneer in a unique transportation plan—the carrying of loaded truck trailers.

Tanker tonnage now constitutes one of the important items of traffic. No individual type of vessel has been developed in this trade except the light-draft tankers designed for use on the New York State Barge Canal.

In 1868, the total number of American vessels on the Lakes (exclusive of canal boats) was 2,543, with a gross tonnage of 454,000, averaging 178 tons per vessel. In 1935 there were 550 American vessels of 1,000 gross tons and over, with a gross tonnage of 2,575,000. Canadian vessels of similar size numbered 285, with a total gross tonnage of 734,000.

AIDS TO NAVIGATION

Various departments of the government assist in providing aids to navigation on the Great Lakes. The U. S. Lake Survey (War Department) publishes and keeps up to date general navigation charts of each of the Lakes, and detailed charts of all harbors and connecting channels and of the St. Lawrence River from Lake Ontario to the International Boundary. It is also constantly engaged in sweeping for shoals and wrecks, and in making observations of Lake levels and river discharges. The Bureau of Lighthouses maintains a most modern system of lights, radio beacons, fog signals, ranges, and channel buoys throughout the American waters, and the Canadian Government performs a similar service on the other side of the boundary. The U. S. Coast Guard maintains a system of life-saving stations and a fleet of cutters and patrol boats for the enforcement of federal laws and for assisting vessels in distress. The U. S. Weather Bureau operates a system of storm-warning stations and forecasts for the Lakes region especially applicable to navigation.

Maintenance of channels and harbor works and the construction of new works is the responsibility of the War Department, and is executed through five district offices supervised by the Great Lakes Division office in Cleveland.

There is nothing remarkable about the package-freight terminals on the Lakes. The bulk-freight terminals, however, are unusual in their mechanical equipment, capacity, and efficiency, as witness the record of loading 12,508 gross tons of ore in $16^1/_4$ minutes, and unloading 12,009 tons in 2 hours and 25 minutes. In general the terminals have been installed by the railroads and are supported by adequate and well-laid-out storage and switching trackage. The efficiency of Lake transportation is due to the combination of economical water haul with highly efficient terminal and railroad operation.

VESSEL OPERATORS AND CREWS

The Lake Carriers' Association was organized in 1892. Its purposes were to establish and maintain assembly rooms for the seamen; to help to establish and maintain aids to navigation and improvements in channels and terminal facilities; to establish and maintain amicable relations between employers and employed; and to provide for the prompt and amicable adjustment of matters affecting shipping.

The success of the Association in accomplishing these purposes has been remarkable. It has demonstrated how an association can be of great service to an industry by studying its problems, improving the conditions of its

IN GOOD YEARS, TONNAGE THROUGH THESE LOCKS EXCEEDS THAT THROUGH SUEZ AND PANAMA COMBINED

A View of the Installation on the St. Marys Falls Canal, Michigan

A Battery of Automatic Ore Unloaders at Cleveland
Over 50 of These Machines Are in Use on the Great Lakes

employees, and presenting facts to the government agencies with which it has to deal. In certain cases the Association has expended its own funds for dredging, and for establishing and maintaining lights, buoys, and light ships when the government was not in a position to do so. It has established a welfare plan for the benefit of sailors; it maintains an excellent library and exchanges books with its vessels; and through its technical committees it is constantly working for safer and better operation, and better maintenance and construction. For twenty years it has conducted schools, in the closed season, for wheelsmen and oilers in its fleet desirous of advancing to officership, and for officers desirous of a raise in grade.

FREIGHT AND PASSENGER TRAFFIC

The efficiency of any system must be judged by the results. So let us look at the record of the volume of commerce on the Great Lakes and the cost of water transportation. The freight passing through the canals at the Soo, which is the best index of Lake transportation, was only 14,500 tons in 1855; the 500,000-ton mark was passed in 1870; in 1876 more than a million tons went by this route; and the peak was reached in 1929 when more than 92 million tons passed through the locks.

During the decade 1926–1935, the average net cargo tonnage of United States ports on the Great Lakes was 114,837,300 short tons. Net traffic in 1936 amounted to more than 138,100,000 net tons, valued at over $1,893,000,000.

Passenger traffic at the United States ports now consists largely of ferry passengers, and during the decade 1926–1935 averaged over 19,000,000 persons per year. Some idea of the traffic on the connecting waterways of the Lakes can be had from the following figures. The Welland Ship Canal, in 1935, showed a movement of over 8,500,000 tons; the New York State Barge Canal traffic in the same year amounted to almost 4,490,000 tons; and traffic on the St. Lawrence River canals in 1933 totaled 6,870,000 tons.

The territory tributary to the Great Lakes is the most important grain-producing district in the world. The peak year in grain shipments from upper Lake ports was 1928, when more than 572,000,000 bu were shipped. The natural flow of grain has of course been from west to east. However, some westward movement has taken place in recent years. In 1935, the total west-bound movement from Buffalo and St. Lawrence River ports was in excess of 7,200,000 bu. Some of this grain even reached Duluth-Superior. During the present season Chicago received 275,000 bu of corn from Buenos Aires by way of New York and the Erie Canal to Buffalo.

Over 1,600,000,000 tons of iron ore have passed down through the St. Marys Falls Canals since 1855. In 1936, the ore movement by Lakes was 50,176,000 short tons. In the same year, 44,000,000 net tons of bituminous cargo coal were carried, which was 6,000,000 tons more than had ever before been moved on the Lakes in a single season. Limestone is another important item in Lake commerce. In 1936, 12,080,000 net tons were transported.

A general idea of the cost of Lake transportation can be had from the following figures: Ore, from Duluth-Superior to Erie ports, including terminal charges, $0.98 per ton; coal, from Erie ports to Milwaukee, $0.50 per ton; and grain, from Duluth-Superior to Buffalo, $1^3/_4$ to 3 cents per bu.

The total expenditures for new work by the War Department on the channels, canals, and harbors of the Great Lakes to June 30, 1936, was $188,083,000. It has been estimated by engineers outside the government service that the savings in freight charges due to water transportation on the Lakes are considerably in excess of $200,000,000 per year.

The existing system of industry and transportation which has been built up around water carriage on the Great Lakes is the result of the cooperative efforts of the federal government, the railroads, industries, municipalities, and vessel owners and operators. At all times the navigation and terminal facilities provided have been reasonably adequate; yet they have never been overbuilt nor has money been spent extravagantly far ahead of requirements. An examination of the record impresses one with the fact that the present results have been obtained by the application of good engineering practice and sound business judgment, and by planning for the future only as far as definite benefits could be foreseen.

Grain Shipments from Upper Lake Ports Have Exceeded Half a Billion Bushels a Year
Grain Elevator at Duluth-Superior

The Proposed Mackinac Straits Bridge

Reviewing Studies Made of a Physical Connection Between Michigan Peninsulas

By James H. Cissel

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Unique among the states in its geographical form, Michigan consists of two peninsulas separated by the Straits of Mackinac, four miles across at the narrowest point. In 1923, in order to develop the upper peninsula, the state initiated a ferry system across the Straits, but the growth of this system has failed to keep pace with increases in highway traffic. Consideration has accordingly been given to a project for constructing a bridge or a tunnel from Mackinaw City to St. Ignace. The great depth of water and the extreme length of the structure required will make the undertaking a very difficult one no matter which of the various plans may be adopted, although a bridge rather than a tunnel connection appears more practicable. The accompanying article, abstracted from Professor Cissel's address of July 23, 1937, at the Detroit Convention of the Society, briefly describes the development of the two principal bridge studies which have been made for the project.

Divided by the Straits of Mackinac into two peninsulas (Fig. 1), the state of Michigan feels the need for a means of communication between them. Although the problem of bridging the Straits has been discussed intermittently for probably more than fifty years, this matter probably first received serious consideration in 1920, when the need for extensive highway development throughout the state had become clearly evident. At that time the late Horatio S. Earle, highway commissioner, suggested a submerged floating tunnel and invited discussion of its feasibility and advantages. A counter-proposal was made by C. E. Fowler, M. Am. Soc. C.E., consulting engineer of New York City, who suggested a series of causeways and bridges starting at a point near Cheboygan and proceeding via Bois Blanc Island, Round Island, and Mackinac Island to St. Ignace (Fig. 2). There were no further developments at that time. In 1923, however, in response to the growing demand for better facilities, the state inaugurated a highway ferry service.

In 1928, after some limited studies, the highway department concluded that it was feasible to build, for about $30,000,000, a highway bridge to be operated as a private toll bridge, directly across the Straits from Mackinaw City to St. Ignace. Although negotiations were undertaken and partially completed for the financing of such a bridge, the project was finally dropped.

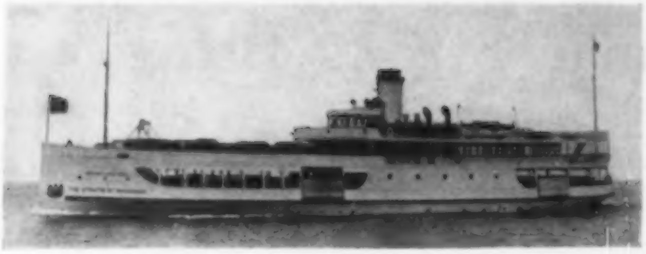
Early in 1934, however, the state legislature created the Mackinac Straits Bridge Authority of Michigan and empowered it to investigate the feasibility of constructing a bridge to connect the peninsulas and to issue and sell the necessary revenue bonds and fix and collect the necessary tolls. In April 1934, Governor Comstock appointed S. T. Stackpole, Otto W. Lang, and Patrick H. Kane as members of the Authority, with Mr. Stackpole serving as chairman.

The Authority immediately engaged the services of Charles Evan Fowler as temporary chief engineer. The plan developed by Mr. Fowler (as described hereinafter) followed closely the one proposed by him in 1920, and in August 1934 the data were arranged in proper form and submitted to PWA with a request for a loan of 70 per cent and a grant of 30 per cent of the estimated cost of the project. This application was formally disapproved by PWA on July 18, 1935.

In the meantime many objections to the proposed route had been brought to the attention of the Authority. As a result, the Authority continued its studies and ultimately reached the conclusion that a direct crossing was both feasible and preferable. The services of Mr. Fowler having been terminated with the rejection on July 18, 1935, of the PWA application relating to his plan, Francis C. McMath, M. Am. Soc. C.E., was engaged to prepare such data on a direct crossing as would be necessary for a new application to PWA. The writer served as consulting engineer for this part of the work. The new application (for the proposed direct route shown in Fig. 2) was submitted to PWA on September 7, 1935. It requested a loan of 55 per cent and a grant of 45 per cent of the estimated cost.

On December 23, 1935, following a request by President Roosevelt, the chief of engineers, U. S. Army, reported on the proposed bridge informally as follows: The construction of the bridge on the direct line proposed, appears to be entirely feasible; it will unquestionably be of great public convenience in facilitating communication between the peninsulas; and there is a reasonable possibility that the revenue from tolls will meet the carrying charges of the loan requested. However, PWA disapproved the

Fig. 1. Highway Map of Michigan, Showing Necessity for Transportation Facilities at the Straits of Mackinac



STATE FERRY-BOAT *The Straits of Mackinac*
This Boat and the *St. Ignace* Have Been Lengthened Twice and Upper Decks Added to Increase Their Capacities

latest application on September 18, 1935, and nothing further has been done in developing the project.

DEVELOPMENT OF STATE HIGHWAY FERRY SYSTEM

The present ferry boats, *St. Ignace* and *Mackinaw City*, were purchased by the state in 1923 and lengthened in 1923 and 1927. An additional boat, *The Straits of Mackinac*, was placed in service in 1928. To provide still greater capacity, upper decks were later added to all three boats and elevators were installed on the docks for loading purposes. The state-owned boats operate from about April 15 to December 15. The schedule varies with the time of year and the volume of traffic. About one hour is required for the trip across the Straits and, with three boats operating, hourly service can be provided. The total capital invested in boats and docks, as of June 30, 1934, was $1,539,020.

During the summer of 1936 the railroad ferry *Sainte Marie* was leased from the Mackinaw Transportation Company and placed in regular highway service for carrying trucks. During the past winter season this boat was continued in service for general highway traffic. Prior to the winter of 1936–1937, the only available service from December 15 to April 15 was provided by the railroad ferry, operated by the Mackinaw Transportation Company. This company carried highway traffic under an agreement which provided that highway tolls be charged and that the highway department pay the company the difference between highway and railroad rates.

Passed in 1923, the legislative act providing for state ferries required tolls to be fixed at such amounts as would provide for operating charges, maintenance, depreciation, and interest on the capital invested. In 1933 this act was amended to provide that tolls take care only of operating and maintenance charges. The amendment also provided that all capital expenditures in excess of accrued profit be charged to and paid out of state highway funds. The effect of this was to relieve the ferry system of accrued obligations in the amount of $785,199.21. The funds actually transferred amounted to $343,479, so that accrued capital charges and depreciation amounting to a total of about $438,700 were apparently forgiven users of the ferry service.

The total traffic carried on state ferries in each year of their operation is shown in Table I. Here, the tremendous increase in trucks, trailers, and buses during recent years is particularly noteworthy. It is also significant that the total traffic has doubled since 1932.

TABLE I. TRAFFIC ON MICHIGAN STATE FERRIES

YEAR	PASSENGER CARS	TRUCKS	TRAILERS	MOTORCYCLES	BUSES	TOTAL VEHICLES	PASSENGERS
1923	10,119	141	65	26	...	10,351	2,418
1924	37,251	839	309	57	...	38,468	12,836
1925	57,813	987	581	92	...	59,484	14,421
1926	72,886	1,379	821	74	...	75,179	13,373
1927	89,820	1,726	1,245	148	...	92,963	163,058
1928	103,634	2,215	1,528	127	...	107,516	183,910
1929	125,427	3,138	2,166	138	39	130,942	222,821
1930	125,223	4,364	2,816	135	73	132,633	222,400
1931	121,353	4,455	3,872	114	57	129,858	220,163
1932	90,316	4,666	3,960	140	35	99,121	173,899
1933	94,496	6,417	6,016	152	83	107,170	192,027
1934	121,940	6,919	9,007	185	251	138,302	243,876
1935	143,882	9,454	10,873	203	424	164,848	288,917
1936	177,434	10,256	13,704	226	1,198	202,819	347,968

Table II presents similar data for traffic carried on the railroad ferry during the winter season. The considerable increase in winter traffic noted in recent years is probably due in no small part to the fact that the now common practice of snow removal makes highways available for service at all times of the year. Attention is also called in Table II, to the very rapid growth in truck traffic.

TABLE II. HIGHWAY TRAFFIC ON RAILROAD FERRY

WINTER SEASON	PASSENGER CARS	TRUCKS	TRAILERS	MOTORCYCLES	BUSES	TOTAL VEHICLES
1928–29	2,858	152	13	..	..	3,025
1929–30	4,102	232	20	..	..	4,354
1930–31	3,777	235	19	2	..	4,032
1931–32	6,303	259	49	2	..	6,613
1932–33	5,158	291	62	3	..	5,514
1933–34	8,262	517	121	3	35	8,938
1934–35	8,416	551	138	..	98	9,203
1935–36	11,077	827	190	11	380	12,485

Ferry traffic fluctuates widely in volume from month to month. Data for a typical year, 1936, indicated that about 50 per cent of the total annual traffic is carried in the months of July and August, which corresponds with the peak of the tourist business in the upper peninsula. However, truck traffic is comparatively uniform for the months of June to November, inclusive. Since 1933, August traffic has been increasing at an average rate of more than 400 vehicles per day.

The response of the public to the service inaugurated in 1923 is reflected in the abnormal growth which occurred in the years 1924 and 1925 (Fig. 3). There then followed a period of uniform growth, corresponding to an annual rate of $22^1/_2$ per cent per year, which was interrupted by the depression. The effect of the depression on ferry traffic appears to have disappeared by the end of 1933, and an average annual rate of growth of 24 per cent has since been maintained. Even if the lower 1925–1929 rate of $22^1/_2$ per cent per year is maintained for the next five years, the traffic in 1942 will amount to 728,000 vehicles. The average rate of growth over the period 1925–1936 is $12^1/_2$ per cent per year, and at this rate traffic in 1942 would amount to 434,000 vehicles. The mean

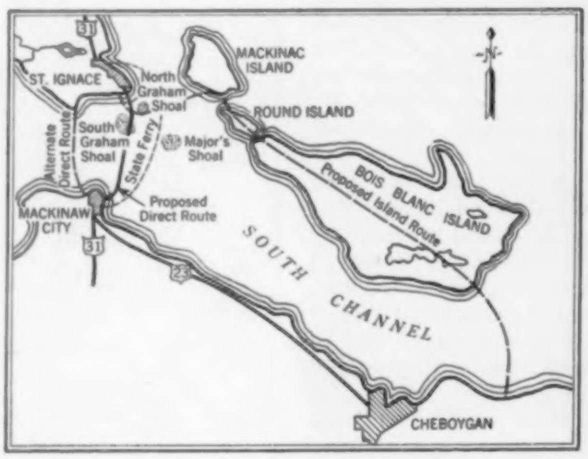


FIG. 2. STRAITS OF MACKINAC AND VICINITY
Showing Three Proposed Locations for a Bridge

Fig. 4. General View of Direct Bridge Crossing
Illustrating Type of Construction for Proposed Direct Route Shown in Fig. 2

of these figures, or about 580,000 vehicles, is believed to be a fair estimate of the probable traffic on the ferries in 1942.

In 1936 traffic reached a maximum daily peak of 2,798 vehicles on August 16, and 2,932 vehicles on September 6. Assuming growth comparable to probable annual traffic, this figure may reach 7,000 vehicles in 1942. In any case it is a measure of the capacity which will be necessary in the future. On a basis of providing for about 70 per cent of the total daily traffic in a 6-hour period, the ferry-boats employed must have a combined capacity of about 800 vehicles, as about one hour is required for each passage.

Since the present combined capacity is only 230 vehicles, this means that new boats with a combined capacity for about 570 vehicles must be procured. It is believed that the following is a conservative estimate of the probable minimum expense of amplifying the present ferry system to meet adequately the requirements of 1942:

Two boats for winter service (capacity 300 vehicles)	$2,000,000
Three boats for summer service (capacity 270 vehicles)	1,050,000
Docks and approaches	950,000
Total	$4,000,000

In accordance with provisions of the act of legislature creating the Bridge Authority, the Authority was granted in 1934 a total of $13,500 from state highway funds for its studies. Requests for funds to provide for more adequate surveys, borings, plan studies, and estimates have been continuously denied. As a result of this obviously inadequate financing of preliminary work, the Authority

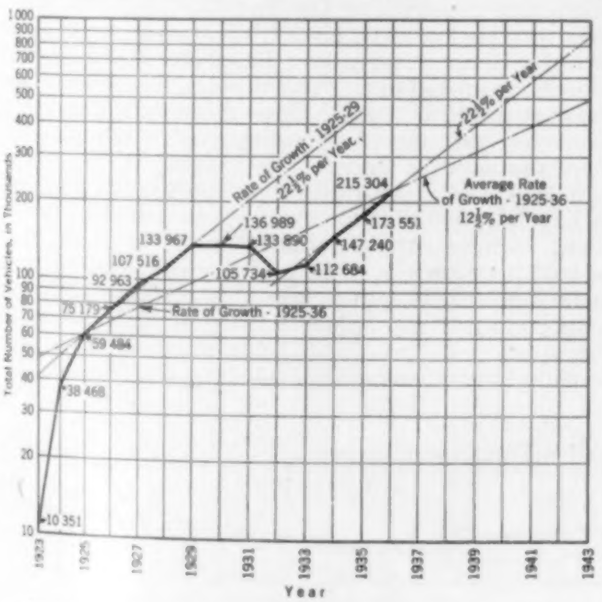


Fig. 3. Rate of Growth of Ferry Traffic, Straits of Mackinac

has been unable to obtain needed data or to make other than limited and approximate design studies and estimates.

Plan for Island-Route Bridge

The plan developed by Mr. Fowler would have involved the following, starting at the shore line of the lower peninsula:

6,800 ft of filled causeway
700 ft of draw span
7,500 ft of simple truss spans (15 spans at 500 ft)
15,200 ft of filled causeway
57,000 ft of earthwork and grading on Bois Blanc Island
2,400 ft of filled causeway
5,300 ft of fill on Round Island
3,000 ft of steel viaduct on fill
2,500 ft of steel cantilever high-level span (1,300 ft of main span)
6,000 ft of steel viaduct on fill
9,600 ft of continuous steel cantilevers (7 spans at 600 ft and 6 spans at 900 ft)
700 ft of draw span
600 ft of simple truss span
9,300 ft of filled causeway

The total length would have been 126,600 ft, or 23.98 miles, from the shore line at the Cheboygan end to the shore line at St. Ignace. It was also proposed to construct, as a part of the project, a railroad connection from Cheboygan to the line of the Pennsylvania Railroad near Brutus. The proposed plan would have provided for

Table III. Estimated Cost of Island Route

Preliminary expenses			$ 50,000
Land, right of way, easements			300,000
Construction cost:			
Superstructure	Steelwork	$11,916,080	
	Pavement on bridges	500,255	
	Railway on bridges	189,000	
Substructure		8,835,550	
Fills and causeways		2,400,000	
Grading on islands		525,000	
Pavement on causeways and islands		1,300,900	
Railways on causeways and islands		1,256,000	
Railway connections	Cheboygan terminal and yard	440,600	
	Line to Pennsylvania RR (near Brutus)	720,000	
Miscellaneous and incidentals		2,886,615	
Total construction cost			$30,970,000
Engineering			1,205,000
Legal, administrative, and overhead			25,000
Interest during construction			2,450,000
Total			$35,000,000

four lanes of highway traffic and a double-track railway. The estimated cost as prepared by Mr. Fowler and submitted in the application to PWA appears in Table III.

Plan for Direct-Crossing Bridge

The location tentatively selected by the Mackinac Straits Bridge Authority is on a line slightly east of a direct line from Mackinaw City to St. Ignace, so as to take full advantage of the relatively shallow water over the Graham Shoals and to cross the shortest expanse of deepest water, as determined by contours of the bottom. The total length of construction between shore lines

THE STATE FERRY DOCK AT MACKINAW CITY
Note the Elevator Installed on the Dock to Load the Upper Decks of the Ferry-Boats

would be 27,330 ft, or 5.18 miles. Starting at the Mackinaw City shore line, the proposed construction would consist of the following:

- 1,800 ft of filled causeway
- 1,000 ft of 8 deck girder spans at 125 ft each
- 600 ft of 3 deck truss spans at 200 ft each
- 1,200 ft of 4 deck truss spans at 300 ft each
- 1,200 ft of 2 simple through truss spans at 600 ft each
- 5,100 ft of continuous cantilever spans—alternate 600- and 900-ft spans
- 2,900 ft of main cantilever span, with a main span of 1,700 ft and 2 anchor arms at 600 ft each
- 3,600 ft of continuous cantilever spans—alternate 600- and 900-ft spans
- 1,200 ft of two simple truss spans at 600 ft each
- 2,100 ft of 7 deck truss spans at 300 ft each
- 800 ft of 4 deck truss spans at 200 ft each
- 1,000 ft of 8 deck girder spans at 125 ft each
- 1,400 ft of filled causeway
- 2,000 ft of 16 deck girder spans at 125 ft each
- 1,430 ft of filled causeway

A general view of the entire proposed construction is shown in Fig. 4. The elevation of the proposed 1,700-ft main cantilever span is shown in Fig. 5. The estimated cost of construction providing for a two-lane highway and single-track railway appears in Table IV.

The shortest distance between the peninsulas, marked "alternate direct route" in Fig. 2, is from Point La Barbe on the upper peninsula to a point west of Mackinaw City (about 3.9 miles), and studies have been made of the possibility of construction on this location. Soundings on this line disclose a greater extent of deep water, with the necessity of locating main piers in water more than 200 ft deep if the main span is made less than 2,300 ft long, and comparative estimates indicate the likelihood of greater construction cost.

While the studies so far made fall short of determining either the most economical design or location, it is believed they have demonstrated that the proposed direct connection is feasible and have determined its approximate cost.

SUMMARIZING RESULTS OF STUDIES TO DATE

The state must evidently choose eventually one of three possible courses, namely, (1) a continuation of the ferry system, amplifying facilities to meet traffic requirements; (2) construction of a bridge to replace the ferries; or (3) construction of a tunnel to replace the ferries.

Continuation of the ferries will necessitate, during the next five years, an investment of probably not less than $4,000,000 for additional boats and improved dock facilities. This capital must be taken from highway construction funds and cannot be repaid from tolls. Scarcely a season passes without ferry traffic being interrupted by storms and other adverse conditions. Operating difficulties will multiply with an augumented fleet, increased traffic, and the necessity for maintaining schedules under adverse conditions.

It has been estimated that an annual gross income of approximately two million dollars would be required to meet capital charges and operating costs for the proposed bridge. Railroad tolls are expected to furnish at least $250,000, so that about $1,750,000 would have to be supplied by highway users of the service. Based on the estimated 1942 ferry traffic of 580,000 vehicles, the average toll necessary for the bridge would be approximately $3 per vehicle. The quicker service given by the bridge and the fact that vehicles will be able to cross at any time of the day or night should produce some increase in traffic, but it is considered doubtful whether such increase would be sufficient to permit tolls to be placed at the figures now charged on the ferries (an average of $1.77 per vehicle) without incurring some loss during the first few years of operation, assuming that the bridge is placed in service in 1942. On the other hand, the bridge would undoubtedly encourage development of the upper peninsula. With continued traffic growth to a volume of about 900,000 vehicles annually, receipts from tolls, if set at present ferry rates, would be sufficient to meet annual costs.

TABLE IV. ESTIMATED COST OF DIRECT CROSSING

Preliminary expenses			$ 13,500
Land, right of way, easements			100,000
Construction cost:			
Superstructure	Steelwork	$14,700,000	
	I-beam lock floor	600,000	
	Railway on bridge	236,386	
Substructure	Piers 1–15 and 36–71	3,131,474	
	Piers 16–35	10,069,800	
Bridge lighting		140,000	
Approach fills		333,200	
Pavement on approach fills		25,235	
Railway on approach fills		38,670	
Total construction cost			$29,274,765
Engineering			1,170,000
Legal, administrative, and overhead			25,000
Interest during construction			1,800,000
Total			$32,383,265

No studies worthy of mention have yet been made of the feasibility or possible economic advantage of a tunnel. Building such a structure on the shortest line would necessitate constructing the invert, at its lowest point, some 350 ft below water level. The over-all length would probably be about six miles. Based on costs of vehicular tunnels completed during recent years, it is believed that the cost would be two or three times that of a bridge; moreover, the annual operating cost would probably place a prohibitive burden on such a project.

Whichever form of utility is provided at this point will be largely responsible for the development of a vast territory, rich in natural resources, and the wealth thus created may amount to several times the entire investment required. Construction of a permanent physical connection will also reduce existing divided interests in the upper and lower peninsulas which at times have actually threatened political subdivision of the state.

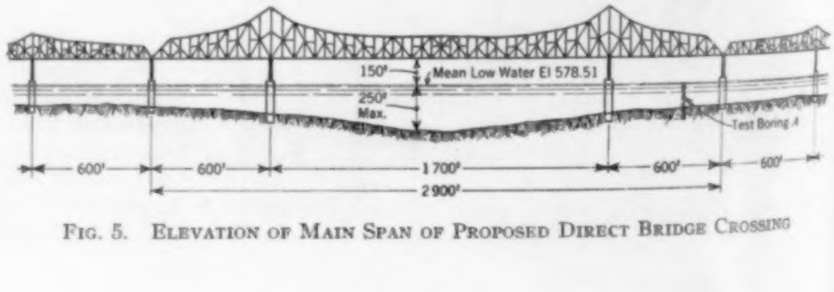


FIG. 5. ELEVATION OF MAIN SPAN OF PROPOSED DIRECT BRIDGE CROSSING

Compensatory Works for St. Clair River

Submerged Sills Proposed to Raise the Level of Lakes Michigan and Huron

By C. R. Pettis, M. Am. Soc. C.E.
Colonel, Corps of Engineers, U. S. Army; District Engineer, U. S. Lake Survey Office, Detroit, Mich.
and Sherman Moore
Senior Engineer, U. S. Lake Survey, Detroit, Mich.

For a considerable number of years, the levels of Lakes Michigan and Huron have been progressively lowered by diversions of water and by enlargement of the channels connecting Lake Huron with Lake Erie. Though the total lowering amounts to less than a foot, its effect on navigation is of considerable importance, and the international questions involved are a matter of common knowledge. To restore the former levels, it is proposed to construct a series of submerged sills in the St. Clair River, the outlet of Lake Huron. For several reasons, no steps are being taken towards this construction at present, but detailed analyses and model studies of the project have been made. Some of the economic and hydraulic factors involved are discussed in the present article, which was originally presented by the authors before the session of the Waterways Division on July 22, 1937, at the Annual Convention of the Society in Detroit.

The elevation of the surface of a lake depends upon the amount of water supplied to it, and upon the capacity of the outflow channel. If the outflow channel is enlarged artificially the outflow will be increased temporarily and the lake level will fall until the outflow again becomes equal to the inflow. Also, if water is drawn from the lake through other than the natural outlet, the level of the lake will fall until the combined outflow through both channels is equal to the net supply.

The channels of the Great Lakes rivers are naturally stable. In the St. Marys, the Niagara, and the St. Lawrence rivers, the flow is controlled by rock ledges. The channels of the St. Clair and the Detroit rivers are, for the most part, in heavy blue clay. Near the head of the St. Clair River there is a constricted section where the bottom is largely sand and gravel; scour might be expected at this point but repeated soundings on monumented sections established in 1899 show no evidence of its having taken place. Further, gage records and measurements of the flow indicate no change in the capacity of the river between 1860 and 1900.

However, since 1900, artificial changes have been made. In the St. Clair River no increase in channel capacity can be charged to improvements for navigation. On the other hand, dredging of sand and gravel for commercial use (prohibited since 1927) has increased the river channel capacity and consequently lowered lake levels in Lakes Michigan and Huron. In addition, diversions of water from the lakes themselves have resulted in still further lowering.

Beginning in 1925, the Joint Board on St. Lawrence Waterway gave considerable study to lake levels. They decided that artificial regulation of the levels was not justified by any benefit which could be secured, but that it was desirable to restore the natural levels. Plans were presented in their report (1926) for works to accomplish this, and the construction was authorized in the River and Harbor Act of July 3, 1930.

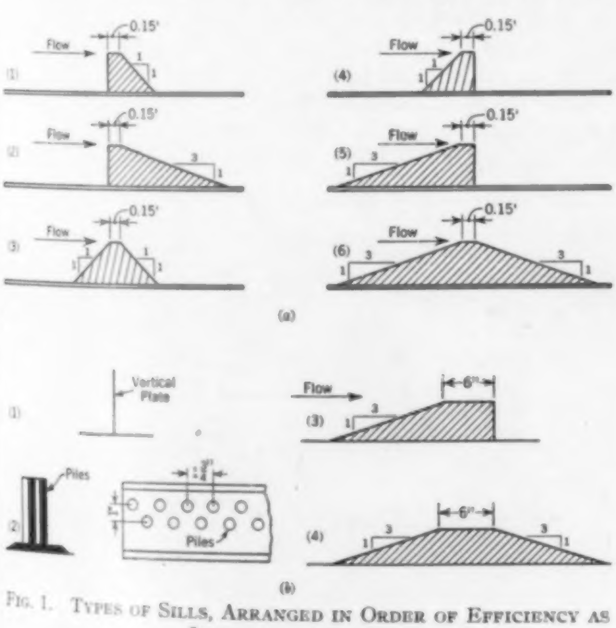


Fig. 1. Types of Sills, Arranged in Order of Efficiency as Indicated by Tests
(*a*) Vicksburg Tests on Distorted Model; (*b*) Ann Arbor Tests

But the Joint Board, in computing the amount the lakes had been lowered, had assumed a diversion from Lake Michigan by the Sanitary District of Chicago of 8,660 cu ft per sec. In a decree dated April 21, 1930, the Supreme Court of the United States ordered that this diversion be reduced, by December 31, 1938, to not exceeding 1,500 cu ft per sec (exclusive of domestic pumpage, which is estimated at 1,700 cu ft per sec). With this decrease in diversion, modification of the plans for the compensating works became necessary, and in 1931, the U. S. Lake Survey Office was instructed to review the report of the Joint Board and to recommend such modifications as seemed desirable.

The Joint Board proposed to raise the level of Lake Erie 0.7 ft by works in the Niagara River, and to raise the level of Lakes Michigan and Huron 0.85 ft by works in the St. Clair River. They estimated that with compensatory works in the rivers, the cost of providing channels 25 ft in depth through and between the lakes would be approximately $1,250,000 less than if such channels were secured by dredging only. The compensating works would also reduce the cost of dredging the harbors on Michigan, Huron, and Erie.

Compensating works proposed for the St. Clair River consisted of 31 sills across the bottom of the channel. They were to be constructed of loose rock, with crests 50 ft wide and upstream and downstream slopes of 1 on 3. A clear depth of 30 ft, and a minimum cross-section of 40,000 ft was required above the crests. The cost of these sills was estimated at $2,700,000.

Revised figures based on a diversion of 3,200 cu ft per sec by the Sanitary District of Chicago show the compensation needed in Lake Erie to be 0.44 ft. The levels

of Lakes Michigan and Huron will have been lowered 0.22 ft by the Chicago diversion, 0.12 ft by diversions from Lake Erie, and 0.39 ft by dredging in the St. Clair River, a total of 0.73 ft. If the level of Lake Erie is restored, the level of Lakes Michigan and Huron will be raised 0.18 ft by the backwater, and the amount of compensation to be secured by works in the St. Clair River becomes 0.55 ft.

The use of submerged sills to increase the fall in the river was adopted because it offered the least restriction to navigation. Where the idea originated is not known. Its possibilities had been considered by the Lake Survey as early as 1905, but the scheme had been rejected because of the apparent impossibility of computing with any degree of accuracy the effect upon the fall.

When a sill is placed in a comparatively uniform stretch of a stream with a constant flow, the effect is to increase the velocity over the crest of the sill in proportion to the decrease in area. The hydraulic principle is the same as that involved in the operation of a venturi-type meter; locally the water surface will be lowered by an amount equal to the increase in the velocity head, but except for the effect of friction and eddy losses there will be no change in the elevations either upstream or downstream. In other words, there will be no backwater rise above the sill. A meter, of course, is designed to reduce frictional losses to a minimum, but the sills should be designed to make them a maximum, in order to produce the maximum backwater rise.

FIG. 2. ST. CLAIR RIVER, SHOWING LIMITS OF AREA REPRODUCED IN MODEL AND LOCATION OF PROPOSED SILLS

The St. Lawrence Board assumed that the frictional loss would be equivalent to half the increase in velocity head. There were no experimental data to substantiate this assumption; but that it is approximately true for natural changes in cross-sectional area, for side contractions, and for bridge piers has been demonstrated by actual observation in large streams.

The type of sill proposed by the Joint Board seemed to approximate too closely the lines of a venturi-type meter to cause a maximum frictional loss, and it seemed probable that greater backwater could be secured by sills of some other type, with possibly considerable saving in the construction costs. The Lake Survey, therefore, made a few experiments in a small flume in the hydraulic laboratory of the University of Michigan.

As the width of the flume was only 2 ft, a model to true scale was out of the question. However, two sills, such as those proposed by the Board, were built of crushed stone to a vertical and longitudinal scale of 1:16, the width being limited by the size of the flume, and observations as to their effect were made, using current velocities and depths based on the Froudian laws of similitude.

These observations indicated that the effect of sills of this kind would be much less than computed by the Board. Additional experiments were then made to determine the effect of sills of different forms. These tests showed that to secure maximum efficiency the upstream face should be vertical.

Upon the recommendation of the Lake Survey, the problem was referred for more detailed study to the U. S. Waterways Experiment Station at Vicksburg, Miss. The experiments made at Ann Arbor were repeated and extended. All of them showed that the flow over such deeply submerged sills differs fundamentally from the flow over the usual dam or broad-crested weir, and that the backwater is primarily a function of the turbulence produced by the obstruction. Sills with vertical upstream faces produced the greatest backwater (Fig. 1), although almost as satisfactory results were secured when the upstream face was built in steps 5 ft high with 1-ft offsets. The slope of the downstream face had much less effect upon the efficiency of the sill, but a sloping face not flatter than 1 on 2 gave somewhat greater efficiency than a vertical downstream face. Results from 18 observations on model sills with vertical upstream faces showed that the backwater rise above the sill, corresponding to the energy lost by friction, was about 57 per cent of the increase in velocity head caused by the obstruction, agreeing reasonably well with the assumption of the St. Lawrence Board. However, with sills of the type proposed by them, the friction loss was but 23 per cent.

After the conclusion of these experiments in the flume, a model of the upper St. Clair River from Lake Huron to a point about 2,000 ft below the mouth of Black River was

DISTORTED MODEL OF ST. CLAIR RIVER, DRAINED, SHOWING REGULATORY SILLS

built, to a horizontal scale of 1:100 and a vertical scale of 1:30 (Fig. 2). The model was about 180 ft in length; the minimum river width was 8 ft; and the maximum depth about 2 ft. In constructing the model, cross-sections of the river about 200 ft apart were cut to scale from sheet metal. These were accurately placed and the bottom between them was molded in sand, over which was placed a thin layer of cement. Ten gages were placed in the model, corresponding in location to gaging stations on the river. These gages were piezometer openings set flush with the surface of the bed and connected by pipes to a central gage pit where elevations were measured by hook gages. The amount of water entering the model was measured by a 5-ft rectangular weir, and a long tail-gate was provided at the lower end of the model to adjust the elevation of the water surface. Preliminary tests showed that to reproduce the natural profile, a larger flow was required than that indicated by the similitude relationship. The roughness of the bed was then increased, but the reduction in the flow was not sufficient, and the experiments were made with a larger flow than was theoretically correct.

After the experiments had been completed on this distorted model, another model was built to true scale. In it the volume of flow and the profile were adjusted satisfactorily to the true similitude relationship. The results obtained from the two models were in substantial agreement and indicated that eight sills with vertical upstream faces would produce the backwater rise required.

As the minimum cross-section of the river will not be reduced by the construction of the sills, the maximum mean current velocity will not be increased. However, the higher velocities will extend farther downstream than at present. The sills will result in a more uniform distribution of velocities across the stream, and will materially reduce the eddy now existing on the Canadian side of the river. It seems probable, therefore, that the actual maximum current velocity may be slightly reduced. It is believed that the sills will not increase the difficulties of navigation.

As the river channel is V-shaped, with depths up to 60 ft and current velocities of 4 to 6 ft per sec, the construction of these sills presents a problem which has not yet been satisfactorily solved. The question of maintenance cost is also uncertain. While the water leaving Lake Huron through the St. Clair River is remarkably free from material in suspension, yet, during heavy northeast storms a certain amount of sand does enter the river. If sand should collect against the upstream faces of the sills to any appreciable extent, their efficiency would be impaired and the removal of the material by dredging would be necessary.

The area of the water surface of Lakes Michigan and Huron is 45,400 sq miles. To build up the surface level 0.73 ft requires the storage of more than 6 cubic miles of water. The lower lakes will be deprived of this amount of water while the storage is being accomplished. This will result in lowering their levels, and will seriously reduce available drafts through the St. Lawrence canals and in Montreal harbor.

Theoretically the full rise in Lakes Michigan and Huron will never be attained. A rise of 0.3 ft will take place in the first three years, and nine-tenths of the ultimate rise will occur in about 6 years. Lakes Erie and Ontario will fall about 3 in. in the first year, and then will gradually rise as the flow from Lake Huron increases. Lake Ontario will be more than 0.1 ft low for about four years.

St. Clair River Model in Operation, Vicksburg, Miss.
The Board Fences Were Erected to Keep Wind from Affecting the Experiments

No steps are being taken towards constructing these sills. Money was allotted for two of them a few years ago, but the Canadian Government refused its consent until higher lake stages should prevail. Probably the whole question will ultimately be referred to the International Joint Commission on Boundary Waters.

There appears to be considerable doubt as to the economic desirability of compensating lake levels at this time. The St. Lawrence Board justified the expenditure by the saving which would result in the decreased amount of dredging needed to provide 25-ft channels between the lakes. But the United States has now deepened these channels to a minimum of about 24 ft, which corresponds to the maximum draft of practically all large vessels on the Lakes. The addition of a foot of depth at this time at a cost of several million dollars does not seem justified.

With the present project completed, the limiting depth for through navigation will be that on the lower sills of the locks at the Soo (Sault Ste. Marie), where there will be an available depth of about 23 ft. Compensation would be beneficial here, but it seems unnecessary to raise the level of all of Lakes Michigan and Huron to obtain it. Records indicate that there may have been a further lowering of the levels of Michigan and Huron within the last few years. The Lake Survey has a party working on the St. Clair River at the present time to determine if this is true. The results of this work may show that some compensation is desirable at the present time.

In the treaty covering the construction of the St. Lawrence Waterway, which has not been ratified, Canada reserved the right to divert into the Great Lakes watershed 10,000 cu ft per sec. It is understood that this refers to the scheme to divert water from the Hudson Bay watershed into Lake Superior for power purposes. If this is done, the levels of the lakes will be fully restored, and the construction of compensation works will be both unnecessary and undesirable.

Problems of Subsurface Utilities

Hit-or-Miss Location Results in Confusion; City Planning Division Proposes a Remedy

THESEUS, who according to the Greeks had troubles aplenty in the Cretan labyrinth, ought to be made the patron saint of municipal engineers. For certainly his shade must sympathize with them as they ponder the intricacies of their twentieth-century mazes—those complexes of conduit and pipe and tunnel that underlie a city's streets.

The underground utility layout of the typical metropolitan area has long since reached such a state of confusion that the smallest extension or the most minor repair to any of the services takes on the aspects of a major operation—and costs proportionately as much. In most cities this confusion is the direct result of a lack of coordinated planning. Sewers and water mains and power conduits and telephone lines must all be accommodated, yet each of these utilities is controlled by a separate agency, and "first come, first served" has been the motto. There has been no coordination of their work.

With a view to bringing some measure of order into the picture, a committee of the City Planning Division has been studying for five years the principles of underground utility planning. Their final report recommends the establishment in each municipality of an "underground agency," charged with the correlation of subsurface utility plans and empowered to allocate space among the various utilities and issue all permits for subsurface work.

The first of the following articles describes briefly the need for this sort of planning; the second outlines the contents of the report just mentioned. Both articles are abstracts of papers presented before the City Planning Division on July 22, 1937, at the Annual Convention of the Society in Detroit, Mich.

Need for Subsurface Utility Planning

By A. W. Consoer

Member American Society of Civil Engineers

President and General Manager, Consoer, Townsend and Quinlan, Chicago, Ill.

MUNICIPAL engineers and city officials are becoming increasingly aware of the inconvenience and woeful waste that result from lack of planning for underground utilities. Laymen, too, in increasing numbers are becoming highly critical of the failure to make intelligent future plans for such things as sewers, water mains, gas mains, steam lines, and power and telephone conduits. They are rightly irritated when they see a new pavement torn up to permit the installation of some subsurface construction which should have been planned and built before the pavement was laid.

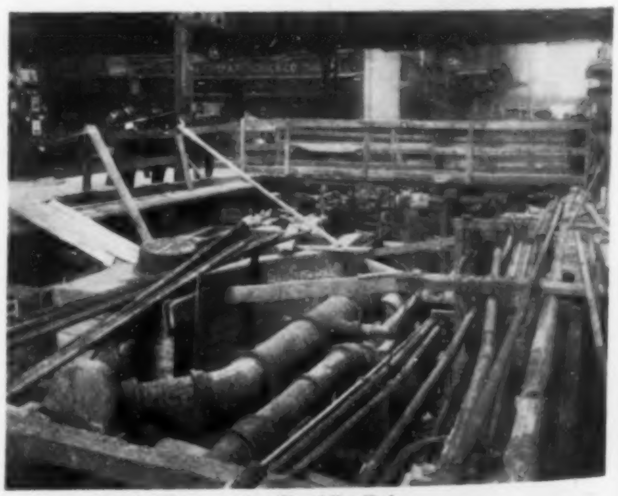
The average layman is intelligent enough to realize that arterial highways are not proper locations for underground utilities that require frequent changes. Yet many engineers have failed to realize the importance of locating such utilities away from major streets. In many cities the principal highways are so cluttered up underground with major utilities on almost identical routings, that no space remains for additional underground construction.

An engineer in designing a filtration plant provides pipe galleries as a matter of routine; on the other hand, seldom does an engineer in municipal work take steps to provide tunnels for underground utilities in congested areas—though such tunnels would facilitate access to the utilities, simplify their enlargement, reduce investments in cable and pipe, prevent breakage, and eliminate destruction of pavements and interruptions to traffic.

Persons seeking information at city offices on the details of existing underground utilities are frequently astounded at the lack of adequate records. In the United States it is a rare city that maintains them. Still fewer cities have made any real attempt to plot on underground plans definite recommendations for future extensions, relocations, and enlargements.

Where records of subsurface construction are maintained at all, they are apt to be inaccurate, incomplete, and poorly organized and indexed. Few city engineering offices have a fixed routine for promptly plotting on atlas sheets records of underground construction of all types as soon as it is installed.

In most cities and towns of the United States there has been no sustained effort to coordinate the subsurface operations of the utility companies, the sewer department, the water department, and other agencies in charge of underground utilities, or to correlate such operations with new paving work. Practically nothing has been done to bring about the organization of effective coordinating committees on the location of underground utilities. But where such committees have been set up—as in Chicago



Courtesy, Board of Transportation, City of New York

Gas and Water Mains Twist Around Obstructions Like the Roots of a Giant Tree

and in Washington, D.C.—much good has been accomplished.

For many years past, cities and towns in the United States have given considerable attention to formulating reliable zoning maps and zoning ordinances, and to the equally important matter of developing city plans. Such work has been publicized so well that by now almost everyone is aware of its importance. However, most city planning has been of the "surface" variety—that is, it has been confined to plans for the development of surface features.

There is at present a very definite need for another phase of city planning—namely, underground planning. For convincing proof of such a need it is only necessary to examine a carefully drawn plot of the structures beneath an important intersection. Even casual study will convince the observer that there is great need for developing, in advance, ideal layouts for such locations. He will behold a confusing array of conduits, manholes, vaults, and catch basins, all located in hit-or-miss fashion with no apparent thought for future enlargements or for the installation of new utilities. In a 5- or 6-point street intersection in the business district of an important city where the streets are none too wide, the entanglement that exists underground usually beggars description, and makes the surface congestion seem slight in comparison.

When Western and Ashland avenues, arterial highways in Chicago, were being improved, I watched with considerable interest the very expensive operations carried on in connection with that work for the renewal, enlargement, relocation, and repair of subsurface utilities. It was not possible to estimate accurately how much of these expenditures could have been saved if the subterranean layout had been carefully planned, but there is no doubt in my mind that such savings would have aggregated several millions of dollars.

Not only in the large cities, but in the smaller ones as well, the economic losses that result from lack of underground planning are tremendous. There may be mentioned, as a simple example, the losses caused by the frequent blockading of pavements in business districts. Such losses can be minimized by a carefully prepared plan, in which underground utilities are located with regard to rational traffic lanes on the surface of the roadway, and in which use is made of parkway and sidewalk space for subsurface construction.

It should also be obvious that smooth, permanent pavements are not possible if underground utilities must be frequently uncovered, as is the case in so many streets today. No matter how skillfully the paving repairs are made afterwards, the smoothness and life of the paving are diminished. Careful underground planning will help here, too, to calm the frenzied motorist's nerves.

It is far more difficult to enunciate specifically the principles for proper underground planning than for ordinary "surface" planning. Underground planning is much limited by the restraining influence of existing underground utilities. Still, in every city and in every region, a start should be made to prevent the recurrence of haphazard allocations of space beneath the thoroughfares.

Some five years ago a Committee on the Location of Underground Utilities was organized in the City Planning Division of the Society. This committee included engineers with electric light and power experience, city engineers, engineers skilled in the ordinary type of city planning, and consulting engineers specializing in municipal improvements. Last October it submitted its final report to the Division, and within a short time copies of that report will be made available for distribution. It is hoped that it may serve to stimulate thought on the subject of underground planning—and, more specifically, that it may encourage the establishment in each city of a definite agency to develop and maintain adequate records of all underground utilities and to bring about the proper installation of future work. The contents of this report are discussed in considerable detail in the following article, by Henry Kranz, M. Am. Soc. C.E.

With the development of a rational and comprehensive underground plan there will be a cessation of the haphazard, wasteful, and confusing construction work that has characterized most subsurface utilities in the past. Such planning will be truly self-liquidating, and should easily find a place in the budget of every forward-looking city.

Principles of Subsurface Utility Planning

By H. H. Kranz

Member American Society of Civil Engineers
Engineer of Highways, Cincinnati, Ohio

THE general public has little or no conception of the problems that lie below the surface. To it, the construction of a new street or the repaving of an old one is just that—a matter of paving. The city engineer, however, knows that the real difficulties lie underground, and that when the underground work on a paving job is completed he usually heaves a sigh of relief and considers the job "licked."

The construction and repair of underground utilities will always be difficult even with the best of planning, for the problem, in addition to being three dimensional, is complicated by the ruling grades of sewer lines, the necessity of avoiding traps in water and gas lines, and so forth. Imagine then the almost hopeless task of attempting to handle even a fairly simple set of underground utilities where no records exist and practically no preliminary planning is possible. Yet this is the condition in a great many cities, and even where there is some system of record and control, it often falls short of what is to be desired. Every city and every region that has not already done so should make a start to prevent the recurrence of haphazard allocation of space for underground utilities.

Underground planning is much more complicated and difficult than surface planning because of the restraining influence of existing subsurface utilities, each of which is a variable, not only controlled by the rate of increase in population but affected differently by the type and changes in type of development that take place in any particular area. It would therefore be an error to assume that a plan could be drawn up for any city which would thenceforth become "The Plan," by means of which all difficulties would be resolved. Were the problem as definite and simple as this, every city could easily be convinced of the value of recording and planning its underground utilities.

The matter of organizing for underground utility planning falls roughly under four heads:

1. Designating the authority or agency to prepare the plan and administer it. This agency need not always be a new department, though this may be necessary in certain municipal organizations. The plan evolved is more likely to be a workable one if the administrative body is a section of the regular engineering staff.

2. Establishing the map of existing underground utilities with its attendant record sheets. This is a step that should be taken only after a thorough investigation of the standards for recording data which have been developed in those localities where underground planning has been in operation for some time. There are a number of factors, some of them local, which must be given full consideration before fixing such items as the scale of the maps and the system of cross referencing. Any change in a map-recording system after it has been in use for some time is a major operation.

3. Adoption of a general policy for assigning locations, and the setting up of regulations for granting permits. This is in a way the most important step in the set-up, for if proper judgment is not exercised in administering the operation all the preceding work will have been wasted. No fixed rule can be set up for assigning locations, especially where old installations exist. Each proposed installation must be judged on its own merits and analyzed like any other construction project. This requires consultation with the official in charge of each of the other underground utilities regarding interference with other present installations or future projects. In most cases conflicting interests can be adjusted, but when they cannot, the decision should be made by the agency and should be conformed to by all concerned.

4. Development of a plan for future major installations of underground utilities. The preparation of such a plan at first thought apalls any one at all familiar with the intricacies of planning for even one utility. However, when it is realized that each of these is a highly developed specialty, the problem of the underground agency resolves itself into fitting together to the best advantage the individual plans prepared by experts for each utility.

Courtesy, Board of Transportation, City of New York

AND NOW, TO FIND ROOM FOR A SUBWAY

A Maze of Utility Conduits Uncovered in the Course of Subway Construction in New York City

For five years the Committee on the Location of Underground Utilities of the City Planning Division has been collecting data relating to standards, successful practice, etc. Its final report, in the form of "An Outline of Suggested Practice for the Location of Underground Utilities," is now being considered for publication by the Society.

The report is divided into three chapters: (1) General Principles Governing Organization of Units; (2) Standards for Recording Data; and (3) General Standards for Design. Chapter I has eleven sections, most of which could be regarded as basic principles in underground planning. It would therefore seem in order to review some of these items.

1. The agency. The underground plans, says the report, "should be developed by some particular agency affiliated with the regular engineering staff of the city or region .... This agency's work should be aided by a coordinating committee organized by the agency, including in its membership a responsible member of the city or regional planning authority and other members who are to be engineers in charge of paving, sewers, and water distribution of each of the municipalities affected, together with properly chosen engineers having authority as to underground distribution for the utilities engaged in gas, steam, refrigeration, electric light and power, telegraph and telephone distribution, together with a few consulting engineers in the municipal field having a practice in the particular area and engineers for the transit companies."

In the beginning of the study some were of the opinion that as the matter being dealt with was one of planning, it should naturally be a function of the regular planning commission. As more data were gathered, however, it became obvious that the personnel, equipment, record maps, and detail sheets were all similar to those already in use by the regular engineering staff of any city or region, and that the duties to be performed were those of a routine and technical nature such as are required of an engineering department and with which a planning organization, whose function is largely advisory, should not be burdened.

2. The plans. These "should include records of all existing underground utilities as well as recommendations for all future work .... Accordingly, the planning work should begin with a properly recorded plat or plat book of all underground utilities. Unless a complete and satisfactory plan of existing utilities is found to exist, its preparation should be arranged for, and should be supervised by the underground agency."

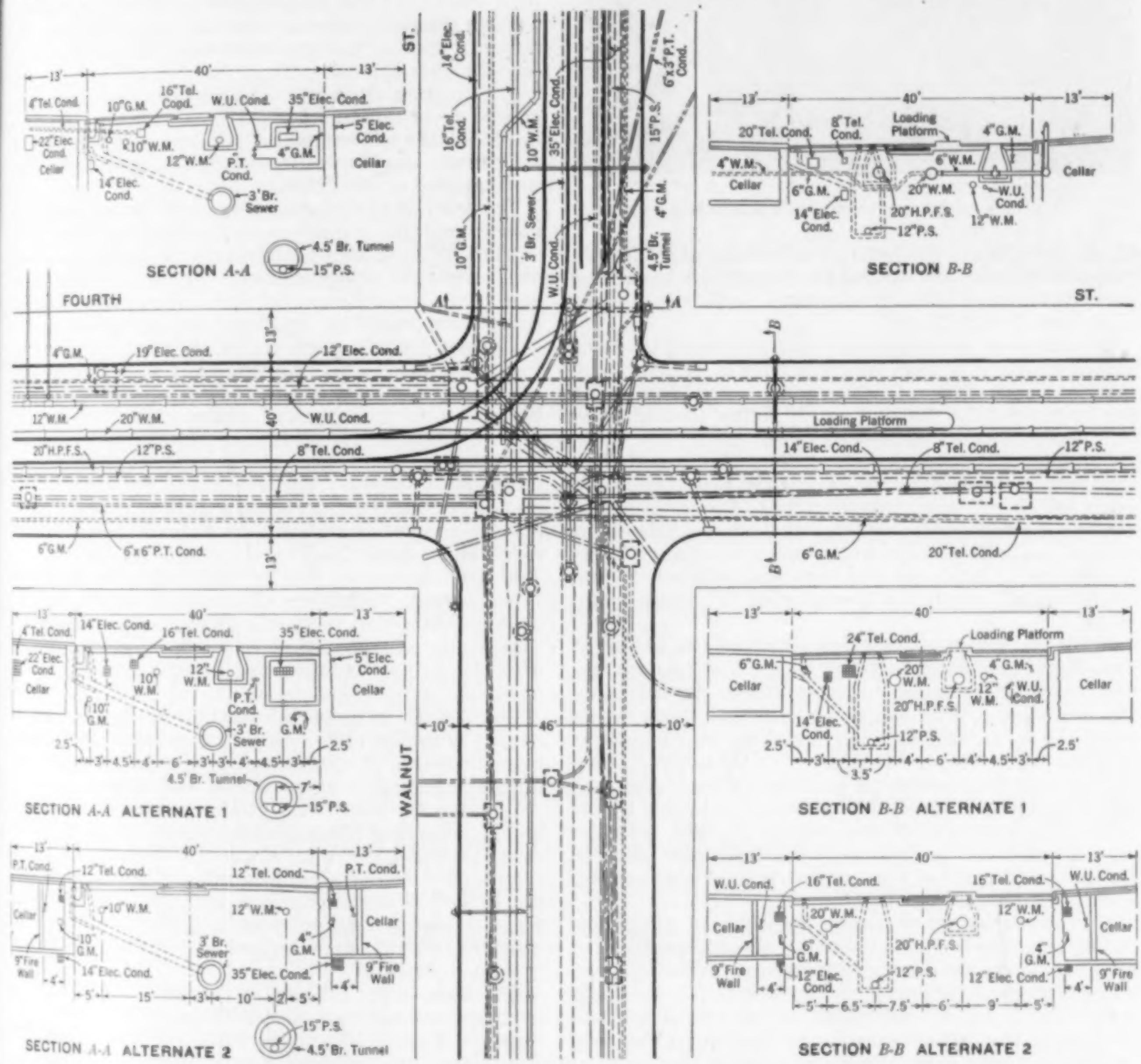
3. Correlation with other plans. "The work of the

underground agency should be closely correlated with the development of major street plans and other features of the city plan or regional plan, but all details of underground planning should be carried out by the engineers familiar with the limitations of various types of underground construction."

The actual planning of the underground facilities is, of course, a highly developed specialty and can only be done by the special engineer of the utility involved. The agency could not pretend to carry in its organization specialists to do this planning for the utilities but should have engineers who are familiar with the various phases of underground engineering so they can deal intelligently with the utilities' engineers and correlate the plans evolved by them.

4. Standards for plans and control. "The underground plans should include standards for: (a) Preparing all maps to be used in underground planning .... (b) Record sheets for depicting new underground construction .... (c) Street cross-sections, depicting recommended locations for underground utilities in various sections and for different street widths. (d) Manholes, vaults, and tunnels for all utilities with particular reference to requirements for length and width. (e) Methods of tapping all utilities with particular reference to possible interference with existing and future underground utilities. (f) Methods for replacing street paving after 'utility cuts.' (g) Permit forms for all underground construction." The Committee has attempted to mention only a few of the items for which standards must be set up if future chaos and confusion are to be avoided.

The rules and regulations for making street openings, the methods for replacing paving after utility cuts, and the permit forms and system to be used for controlling utility cuts are matters requiring deep study and considerable experience. Even where this control has been



Tel. Cond. = Telephone Conduit; P.T. Cond. = Postal Telegraph Conduit; G.M. = Gas Main; W.M. = Water Main; Br. Sewer = Brick Sewer; Elec. Cond. = Electric Conduit; Br. Tunnel = Brick Tunnel; P.S. = Pipe Sewer; H.P.F.S. = High-Pressure Fire System; W.U. Cond. = Western Union Conduit

Typical Layout of Existing Underground Structures (Business Section of Cincinnati, Ohio) and Two Alternate Studies for "Ideal" Relocation

practiced for years there is constant need for change and revision. The details depend on whether the city does all restoration work itself, or whether certain utilities are permitted to do their own restoration work, or whether all restoration work is done by the permittee. If the city is to make all restoration, then fair prices must be arrived

Courtesy, Board of Transportation, City of New York

A MAJOR OPERATION ON A CITY'S NERVE-SYSTEM

at, so that charges per square yard can be made for the proposed opening at the time the permits are issued and deposits taken sufficient to guarantee to the city the cost of the work.

The time and labor expended for formulating rules and cost is of course wasted unless a reliable system of inspection is installed. This inspection should begin with the opening of the cut and should follow through until complete restoration is made.

5. The future plan period. "The underground plans should be developed for the needs of at least five future years and should be revised from time to time . . . and in any event, details of the underground planning should be worked out and executed well in advance of any paving operations. To this end administrative authority should be developed to care for execution of the underground plans."

Actually the five-year period set up in the suggested procedure is merely a tentative figure, and that for any one community may be longer or shorter depending on the conditions. The length of time for which future plans can be made will be governed by such factors as increase in population, development of industrial centers, and changes from residential to industrial use. The possibilities of planning will also be controlled largely by the type of organization of the various utilities—whether they are privately or publicly owned, whether units in themselves or parts of a larger system, and whether progressive or old-fashioned.

6. Correlation with other construction programs. "The work of underground planning should be correlated by the underground agency with all construction agencies doing work in the streets . . . to the end that openings in the street paving and sidewalks may be minimized, and to the end that interruption to the flow of vehicle and pedestrian traffic may be reduced, and so that costs of installing future underground utilities may be minimized."

7. Unnecessary street openings. "The underground agency should be vigilant in discouraging unnecessary openings in the street paving and sidewalks. . . ."

As a special feature of the reduction of the number of street openings, special studies should be made in each community as to the possibility of utility tunnels. Some successful installations are in operation, notable among which is the system in use at St. Paul, Minn., and numerous studies have been made suggesting installations both under the traveled roadway and in the sidewalk space.

8. Power to assign space. "The underground agency should have power to assign to the various utilities locations conforming to the underground plans, and permits for construction in accordance therewith should not be issued without the approval of the underground agency. Their jurisdiction should extend to permits for construction of fuel-oil tanks and filling pipes in public spaces, and to vault space for basement storage or other private use, when located within the street or alley lines. . . ."

Obviously this power to assign space must be judiciously used, but equally obviously a power of decision must exist, and the proper place for it is in the agency. Though this may seem to endow the agency with despotic power, it should be remembered that there are possibilities of higher appeal.

9. Financial support. "The operations of this underground agency if not supported by the municipality may be placed on a self-sustaining basis by a system of charges for permits, for inspection and recording location of all underground public utilities. . . ."

One method of financing is to make the operations of issuing permits, inspection, and street restoration self-supporting by charges based on accumulated cost records; while the field and office work involved in locating and recording underground installations and assigning space is supported by direct budget appropriation.

Chapter I concludes with the following recommendation: "Because of the lamentable lack of underground plans in most municipalities and metropolitan areas, and because of the great need of systematizing the records of existing underground utilities, it should be one of the functions of the city planning or regional planning commissions to suggest and encourage the formation of underground agencies as described above, and to suggest and encourage preparation of underground plans and the execution of same."

A strict adherence to the title of the present article would permit overlooking Chapters II and III entirely. They do, however, contain a great deal of information that will be of real value to any official who is charged with the duty of building up an underground planning unit.

Chapter II includes information on scale of maps, quality of tracing cloth, coloring, binding, scale of master plan, depicting of grades and profiles on detail sheets, filing system and cross references, and so forth.

Chapter III deals with general standards of design, and includes such items as advantages of correlated planning, proper trunk-line location, avoidance of traffic interference, advantages of tunnels and pedestrian underpasses, use of sidewalk spaces and alleys, and a list of plates showing cross-sections and plans of streets of different widths with suggested locations for underground utilities.

The data in the committee's report, though far from complete, are sufficient to indicate most of the basic principles. Though it is not as yet a complete "Manual of Procedure," it should serve as a nucleus for further accumulation of data on the subject, and may aid in the difficult problem of setting up in various municipalities and planning regions a comprehensive program for the recording, planning, and control of the location of underground utilities.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems.

A Drive-on Rail Clip

By George W. Hunt

Maintenance of Way Inspector, Baltimore and Ohio Railroad, Baltimore, Md.

In Fig. 1 is shown a pair of spring steel clips designed to maintain a pressure of 2,000 lb between rail base and tie plate. This pressure will give a sliding resistance of 1,000 lb between rail and plate, equal to the probable tie resistance offered by the ballast.

The design involves raising the tie plate shoulders $^1/_4$ in. higher than is customary in present practice. The usual spike holes through the shoulder are omitted, and the slots for the clips are located well outside the thickened area, thus simplifying the punching. These slots are so placed with reference to the tie-plate shoulders as to permit a universal clip regardless of tie-plate cant.

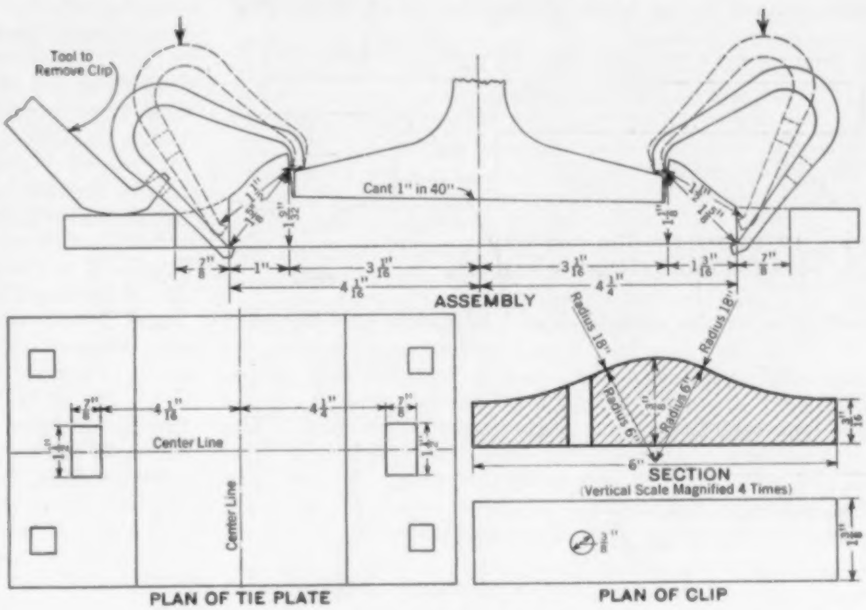


Fig. 1. Details of Drive-on Rail Clip

High-quality spring steel, with an elastic limit of 125,000 lb per sq in. is used in the clips. The dimensions as shown on the drawing provide a lever arm of 2.75 in. from the center of the clip to the jaws. The moment of inertia and the section modulus at the center of the clip are 0.006 in.^{4} and 0.032 in.^{3}, respectively. With the steel stressed to the limit, the tensile force between the jaws is $125{,}000 \times 0.032/2.75$, or 1,450 lb. The resulting pressure of rail base on tie plate (for a pair of clips) is $2 \times 1{,}450 \times 0.74$, or 2,140 lb (0.74 is a factor indicating the vertical component of the force acting between the jaws). The opening between the jaws, unsprung, is 1.500 in., and the spread on application is $[2 \times 1{,}450 \times (2.75)^3] \div [3 \times 30{,}000{,}000 \times 0.006]$, or 0.112 in. based on a uniform rectangular section. A jaw spread of 0.125 in. under application is recommended as giving the desired pressure within the elastic limit, considering the thinning of the arms at the jaw ends.

The clips weigh about 10 oz. They should be made at a cost of about 6 cents each, or $648.00 per track mile. The cost of applying them will not exceed $50.00 per mile and is more than offset by the labor saved in applying joints.

About 60 hand-made clips of essentially this design were recently installed and have functioned perfectly. They are on the west-bound main track of the Baltimore and Ohio Railroad between Baltimore and Washington, D.C., about one mile from Baltimore.

Practical Curve Alinement by Use of String-Line Method

By Adolph J. Hartman

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There are many ways of attacking the problem of alining a railroad curve by the use of the "string-line" method. This article deals with a refinement of what is generally called the "bracket method" of computation.

It is assumed that the reader is familiar with the general principles of string-lining. It need only be recalled that when an arc of given length is subtended by a chord, the mid-ordinate is proportional to the degree of curvature. The problem solved here is based on the use of a 62-ft chord, for which the mid-ordinate in inches equals the curvature in degrees. The distance between stations is of course half the length of the chord—in this case, 31 ft.

To secure satisfactory results, string-lining must be done with the greatest care. The stationing of the curve should begin at least five stations ahead of the P.C.

and end not less than five stations beyond the P.T. Each station should be clearly indicated by an arrow on the base of the rail, and numbered, preferably on the web of the rail. All pertinent physical data, such as inter-track distance, side clearances, and location of turnouts, should be incorporated in the field notes. A good grade of fish line may be used for the string. It should be held in a device similar to that shown in Fig. 1. This will bring the string to the elevation of the gage point ($^5/_8$ in. below the top of the rail), and 1 in. from the gage line. The latter provision makes it possible to take the negative readings that are sometimes required on tangent track.

After the curve has been stationed and all necessary data entered in the notes, the measurements at the mid-

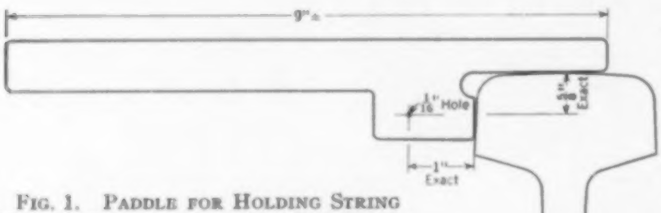

FIG. 1. PADDLE FOR HOLDING STRING
The 1-In. Offset Permits Negative Readings

ordinates of the chords should be taken and recorded (Table I, Col. 2). In the case under consideration, the first reading is taken at Station 1, with the ends of the cord held at Stations 0 and 2. The zero reading verifies the fact that these three stations are on tangent. The next reading is at Station 2, with the cord held at Stations 1 and 3, and so on around the curve. In recording the ordinates, allowance is of course made for the 1-in. offset of the string. For these measurements it is convenient to use an ordinary 6-ft rule marked with its cumulative total of $^1/_{16}$ in. divisions, beginning at the 1-in. mark.

The first step in the computation is to determine the probable degree of curvature for the main portion of the curve. This can be done by averaging the ordinates of the main curve arithmetically, or by visual inspection of the data when plotted as in Fig. 2. (The average ordinate, $^{27}/_{16}$ in., indicates a curve of approximately 1 deg 41 min, which is represented by the horizontal dashed line.) The lengths of the spiral curves connecting the circular curve to its tangents are then determined in accordance with the standard practice of the railroad. On Fig. 2, these spirals are represented by the diagonal dashed lines, which can be moved left or right as necessary to approximate most closely the existing ordinates.

Next, the desired ordinates for curve and spirals are read from Fig. 2 and recorded in Table I, Col. 3; and Col. 4 is computed as the algebraic difference between Col. 3 and Col. 2. The entries in Col. 4 are thus the plus and minus ordinates that will change the original curve to the desired curve. The problem now is to compute the throws required to effect these changes.

Let us first consider Stations 5, 6, and 7. Opposite Station 6, a change of −2 in the mid-ordinate is needed. But if Station 6 is thrown a −2, the ordinates at Stations 7 and 5 will be changed by half this amount with the sign reversed—that is, by +1. Under Col. 6 these three changes are recorded in box *A*. The throw of −2, or $-^2/_{16}$ in., at Station 6, is recorded in Col. 7. (A minus throw indicates movement of the curve towards the center of the curve, and a plus throw movement in the opposite direction.) The changes in ordinates indicated in group *A* are then subtracted from the entries in Col. 4, and the differences are recorded in Col. 5. The zero entries for Stations 5 and 6 show that no more change is necessary at these points. At Station 7, a +1 change is still to be made.

Stations 7 to 12 are now examined. To reduce the algebraic difference at Stations 7 and 8 to zero, it is necessary to apply a +1 change at both stations. By visual inspection it is seen that both Station 11 and Station 12 can also be changed a +1, which reduces their algebraic difference to +1 and zero, respectively. A −2 change at Station 9 will produce the desired +1 changes at Stations 7 and 8, and likewise a −2 change at Station 10 will produce the +1 changes at Stations 11 and 12. As we now have a symmetrical group, with the algebraic sum of the changes equal to zero, we arbitrarily use these two −2 and four +1 changes and note the changed algebraic differences in Col. 5. As the ordinate at Station 9 was reduced by −2, it has been reduced −1 too much, which changes its remaining algebraic difference to +1 as shown in Col. 5. In order to complete the necessary changes at Stations 9, 10, and 11 to reduce the algebraic differences to zero, group *C* in Col. 6 must be applied.

To determine the throw at these

TABLE I. SOLUTION OF TYPICAL STRING-LINING PROBLEM

(All Values Are in Sixteenths of an Inch)

STATION (1)	ORIGINAL ORDINATE (2)	DESIRED ORDINATE (3)	ALGEBRAIC DIFFERENCE (4)	REDUCED ALGEBRAIC DIFF. (5)			STEPS IN REDUCING ALGEBRAIC DIFF. (6)			THROWS (7)			TOTAL THROW $^1/_{16}$ IN. (8)
0													0
1	0	0	0										0
2	0	0	0										0
3	0	0	0										0
4	0	0	0				A						0
5	0	1	+1	0			+1			A			0
6	6	4	−2	0			−2	B		−2			−2
7	5	7	+2	+1	0		+1	+1			B		0
8	9	10	+1		0			+1	C		−2		−2
9	14	13	−1		+1	0		−2	+1		−6	C	−6
10	20	16	−4		−2	0		−2	−2		−6	−2	−8
11	17	19	+2		+1	0		+1	+1		−2		−2
12	21	22	+1		0			+1					0
13	25	25	0				D						0
14	28	27	−1	0			−1	E		D			0
15	24	27	+3	+2	0		+1	+2		+2	E		+2
16	32	27	−5	−4	0		−1	−4		+2	−4		−2
17	25	27	+2		0			+2		+4			+4
								F					
18	30	27	−3		0			−3	G	+6	F		+6
19	25	27	+2			0			+2	+8	+6	G	+14
20	23	27	+4		+1	0		+3	+1	+10	+12	−4	+18
21	23	27	+4	+2		0	+2		+2	+12	+12	−10	+14
22	23	26	+3		0			+3		+10	+12	−20	+2
23	28	23	−5			0			−5	+8	+6	−30	−16
24	28	20	−8		−5	0		−3	−5	+6		−30	−24
25	17	17	0							+4		−20	−16
26	13	14	+1	+2		0	−1	H	+2	+2		−10	−8
27	8	11	+3	+2	+1	0	+1	+1	+1	+2	H	−4	−2
28	7	8	+1	+2		0	−1		+2		−2		−2
29	6	5	−1		0			−1			−4		−4
30	3	2	−1		0			−1			−4		−4
31	0	0	0								−2		−2
32	−1	0	+1		0			+1					0
33	0	0	0										0
34	0	0	0										0
35	0	0	0										0
36													0

stations, group B in Col. 6 must be analyzed. Station 7 is considered first. To make this +1 change of ordinate, if no other ordinate were to be changed in the remaining portion of the curve, Station 8 would have to be thrown $^2/_{16}$ in. towards the center—that is, a −2 throw; Station 9 would have to be thrown a −4; Station 10, a −6; and so on.

Similarly, to make the +1 change at Station 8 without affecting the ordinates of the remainder of the curve, Station 9 would have to be thrown a −2; Station 10, a −4; Station 11, a −6; and so on.

The −2 change in ordinate indicated in group B for Station 9 would similarly be made by throwing Station 10 a +4; and to avoid changes in the rest of the curve, Station 11 would have to be thrown a +8; Station 12, a +12; and so on. Table II summarizes all these steps for Stations 7 to 12 inclusive. It is seen, then, that the total throws indicated for Stations 8, 9, 10, and 11 will produce the desired change in ordinates at Stations 7 to 12 for group B.

Table II. Detailed Computation of Total Throws

Sta. No.	Change in Ord.	Throws to Change Ordinate of: Sta. 7	Sta. 8	Sta. 9	Sta. 10	Sta. 11	Sta. 12	Total Throw
7	+1							0
8	+1	−2						−2
9	−2	−4	−2					−6
10	−2	−6	−4	+4				−6
11	+1	−8	−6	+8	+4			−2
12	+1	−10	−8	+12	+8	−2		0
13		−12	−10	+16	+12	−4	−2	0
14		−14	−12	+20	+16	−6	−4	0
15		−16	−14	+24	+20	−8	−6	0

It is not actually necessary to go through this lengthy procedure to determine the throw for any particular station. The same result is obtained by taking the algebraic sum of the changes in ordinates above the station in question, doubling it, changing the sign, and adding it algebraically to the throw for the preceding station. For example, to compute the throw for Station 9, take the sum of the ordinate changes at Stations 7 and 8 (that is, +2), double it and change the sign (−4), and add it to the throw already determined for Station 8, which is a −2. The result is −6. At Station 10, the algebraic sum of ordinate changes at preceding stations is zero, which causes the throw to remain a −6 for that station.

In like manner, the throws for groups C, D, E, F, G, and H are determined, and entered in the proper position in Col. 7.

For a fast, successful solution, it is of primary importance to recognize and make use of symmetrical "blocks" or "bracket" groups. A "bracket" may extend across any number of stations, as shown by block D. In reality, block D is composed of two brackets, one extending from Station 16 to 26, and the second overlapping it and extending from Station 14 to 28.

It will be observed that all groups are symmetrical about a center line or band. This line of symmetry may be imagined to pass through the middle of the −2 change of ordinate in group A, to lie between Stations 9 and 10 for group B, to pass through the middle of the +2 change of ordinate in group D, and so on. The throws in Col. 7 likewise are symmetrical about the same lines or bands. It would be possible to disregard this rule of symmetry, but the speed with which the throws can be set down when using it largely offsets any advantages that might be attained by the use of any other method.

After all the desired changes in mid-ordinates have been accomplished and all the throws have been computed, the total throws are tabulated under Col. 8. Computations are not complete, however, until the total throws are checked against the original and computed

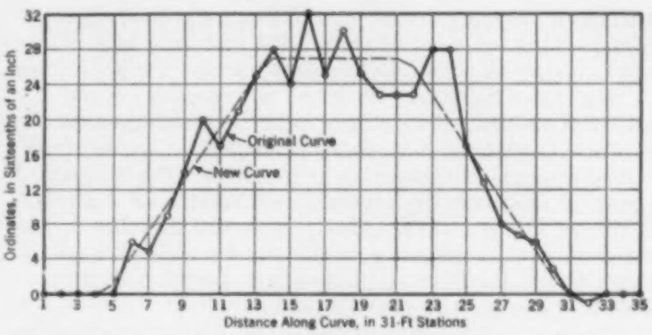

Fig. 2. Original and Adjusted Ordinates of Curve of Table I

ordinates. In the check, the process of computing throws is reversed. For example, let us check Station 17. The total throws for Stations 16 and 18 are added algebraically (+4). Half of this throw, with the sign changed (−2), algebraically added to the throw for Station 17, gives a total of +2, which when added to the original ordinate of that station (+25, in Col. 2) checks the desired ordinate (+27, in Col. 3).

The entire column of throws must be checked in like manner. If it so happens that an error has been made, corrections can easily be made. For example, if the throw at Station 18 had been totaled erroneously as +4, the check of Station 17 would give a computed ordinate of +28 for the new curve. This new ordinate of +28 would replace the +27 ordinate and the check would be continued. At Station 18, it would be found that the desired ordinate would have decreased to a +25; at Station 19, the ordinate would have checked out to be +28. A +2 "bracket adjustment" would then be made immediately on Station 18, which would affect Stations 19 and 17 by a −1 change and would even up the curve to an ordinate of +27.

The curve is now ready to be staked out and alined. It has been found that $1^1/_2$ by $1^1/_2$ by 18-in. oak stakes, set in holes drilled in the ballast with a sharp-pointed lining bar and driven flush with the tops of the ties, will give satisfactory and permanent results. It is well to have the same person who sets the tacks originally make the throw measurements. In this way, any errors due to peculiarities in setting the stakes or in measuring the tacks will be overcome.

Finally, after the work has been completed and one or more trains have used the track, a most important check must be made by again string-lining the entire curve. This last detail, often neglected, gives an opportunity to check all phases of the work, including the possibility of an inaccurate reading of the original mid-ordinate, inaccuracies in the setting of the tacks, or a slight movement of the stake while the curve was being adjusted.

Shear Deformation Included in Three-Moment Equation

By A. Floris
Los Angeles, Calif.

It is generally admitted that lateral earthquake forces can best be transferred to the foundation by means of floor slabs. These concrete slabs are usually continuous over several walls, and can therefore be analyzed by the three-moment equation. In its standard form, however, this equation does not include the in-

fluence of shearing forces on the moments over the supports. This omission is ordinarily perfectly legitimate; but in a slab subjected to horizontal loads, the work done by the shearing forces may be appreciable, since the width of the slab (which here is to be considered as the depth of the beam) is so great in proportion to the span.

The purpose of this article is to derive a three-moment equation in which the shearing deformation is included. It can be applied in the same way as the standard three-moment equation, and actually the introduction of the shear terms facilitates the solution, by making it possible to apply the principle of iteration.

The usual sign conventions, as indicated in Fig. 1(*a*) and (*c*), will be employed.

In Fig. 1(*a*), θ_n is the slope, at support n, of the elastic curve to the left of n, and θ'_n is the corresponding slope of the curve to the right. $E\theta_n$ and $E\theta'_n$ are expressed by

$$E\theta_n = \frac{L_{n-1}}{I_n l_n} + \nu \frac{F_n}{A_n l_n} \quad . \; . \; . \; . \; . \; . \quad [1]$$

$$E\theta'_n = \frac{R_{n+1}}{I_{n+1} l_{n+1}} - \nu \frac{F_{n+1}}{A_{n+1} l_{n+1}} \quad . \; . \; . \quad [2]$$

The factor ν depends on the shape of the section and the value of Poisson's ratio for the material composing the beam. For rectangular concrete sections, $\nu = 2.8$; for rectangular steel sections, $\nu = 3.0$, determined from the well-known expression, $\nu = \kappa \dfrac{2\,(m+1)}{m}$, in which κ equals 6/5 for rectangular sections of any dimension, and m is Poisson's constant having an experimental value of 6 for concrete and 4 for steel. The negative sign in Eq. 2 takes into account the convention that the shearing forces acting to the left and right of a section have opposite signs.

L_{n-1} and R_{n+1} represent the static moments of the bending moment areas [Fig. 1(*b*)] about supports $n-1$ and $n+1$, respectively, and are expressed by

$$L_{n-1} = L_{o(n-1)} + \frac{l_n^2}{6}\,(M_{n-1} + 2M_n) \quad . \; . \; . \quad [3]$$

$$\text{and } R_{n+1} = R_{o(n+1)} + \frac{l_{n+1}^2}{6}\,(M_{n+1} + 2\,M_n) \quad . \; . \quad [4]$$

in which $L_{o(n-1)}$ and $R_{o(n+1)}$ represent the static moments, about $n-1$ and $n+1$, of the areas of the bending moments M_{on} and $M_{o(n+1)}$ (of the free-end beam).

Curves for the shear produced by the moments at the supports are shown in Fig. 1(*c*). The areas under these curves are

$$F_n = M_n - M_{n-1} \quad . \; . \; . \; . \; . \; . \; . \quad [5]$$

$$\text{and } F_{n+1} = M_{n+1} - M_n \quad . \; . \; . \; . \; . \; . \; . \quad [6]$$

Substituting Eqs. 3 to 6 inclusive, into Eqs. 1 and 2, and remembering that $\theta_n = -\theta'_n$, the generalized three-moment equation is obtained:

$$M_{n-1}\left(\frac{l_n}{I_n} - \frac{6\nu}{A_n l_n}\right) + 2\,M_n\left[\frac{l_n}{I_n} + \frac{l_{n+1}}{I_{n+1}} + 3\nu\left(\frac{1}{A_n l_n} + \frac{1}{A_{n+1} l_{n+1}}\right)\right]$$
$$+ M_{n+1}\left(\frac{l_{n+1}}{I_{n+1}} - \frac{6\nu}{A_{n+1} l_{n+1}}\right) = -6\left(\frac{L_{o(n-1)}}{I_n l_n} + \frac{R_{o(n+1)}}{I_{n+1} l_{n+1}}\right) \quad . \; . \; . \quad [7]$$

If the section of the beam is constant in all spans, Eq. 7 becomes

$$M_{n-1}\left(l_n - 6\nu\frac{\gamma}{l_n}\right) + 2\,M_n\left[l_n + l_{n+1} + 3\nu\gamma\left(\frac{1}{l_n} + \frac{1}{l_{n+1}}\right)\right]$$
$$+ M_{n+1}\left(l_{n+1} - 6\nu\frac{\gamma}{l_{n+1}}\right) = -6\left(\frac{L_{o(n-1)}}{l_n} + \frac{R_{o(n+1)}}{l_{n+1}}\right) \quad . \; . \; . \; . \; . \quad [8]$$

in which $\gamma = I/A$.

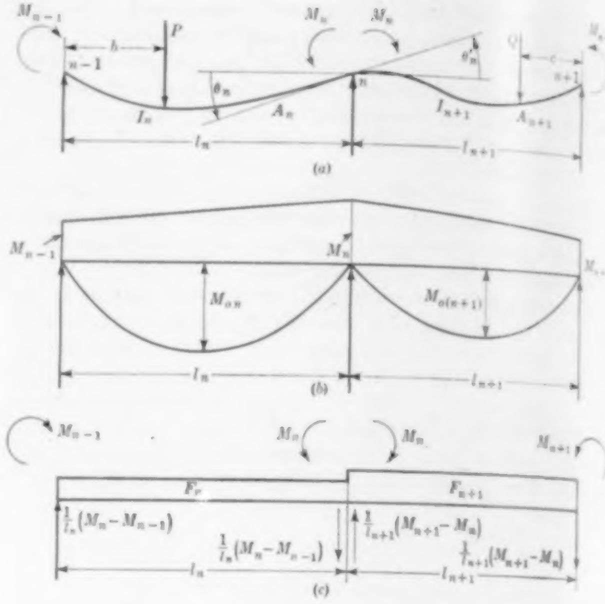

FIG. 1. NOMENCLATURE
(*a*) Elastic Curve; (*b*) Moment Curve; (*c*) Curve of Shear Produced by Moment

Neglecting the influence of shear, that is, omitting all terms multiplied by $\nu\gamma$, Eq. 8 reduces to the standard three-moment equation.

For computing $L_{o(n-1)}$ and $R_{o(n+1)}$ the following formulas can be used. If the beams to the left and right of n have uniform loads of p and q, respectively, per unit of length,

$$L_{o(n-1)} = \frac{pl_n^4}{24} \qquad R_{o(n+1)} = \frac{ql_{n+1}^4}{24}$$

If the beams are loaded with the concentrated loads P and Q at a distance b and c from the supports $n-1$ and $n+1$, respectively, Fig. 1(*a*), then

$$L_{o(n-1)} = \frac{Pb}{6}\,(l_n + b)\;(l_n - b)$$

$$\text{and } R_{o(n+1)} = \frac{Qc}{6}\,(l_{n+1} + c)\;\;(l_{n+1} - c)$$

If P and Q act in the middle of the spans,

$$L_{o(n-1)} = \frac{Pl_n^3}{16}\text{, and } R_{o(n+1)} = \frac{Ql_{n+1}^3}{16}$$

If several concentrated loads are acting on the beam, $L_{o(n-1)}$ and $R_{o(n+1)}$ can be obtained by superposition.

In solving Eqs. 7 and 8, the moments always become negative. This means that their directions are opposite to those assumed in Fig. 1(*a*) and (*c*).

The application of the standard three-moment equation to the analysis of a beam over several supports is somewhat impractical because of the simultaneous equations involved. For their solution the accuracy of the ordinary slide rule is not sufficient, and in such cases many engineers prefer to use graphical methods. But in applying the proposed three-moment equation to continuous beams of considerable depth and short span, the solution of the simultaneous equations can be facilitated by the use of iteration, or repeated approximations, as stated previously.

This method of solving simultaneous equations is applicable whenever the elements of the diagonal in the

determinant falling from left to right are considerably greater than the other elements. In the present problem this is the case, because the shear terms are subtracted from the coefficients of the end moments and added to the coefficient of the middle moment. The greater the influence of the shearing forces, the more rapid will be the convergence of the values of the moments over the supports.

To demonstrate the application of the generalized three-moment equation, a typical problem will be solved. In Fig. 2, the continuous beam over five supports represents a corridor slab which has to resist the uniformly distributed lateral earthquake loads, as shown. (In the reconstruction of the school buildings in Los Angeles and vicinity, after the Long Beach earthquake of March 10, 1933, such corridor slabs have been used frequently to transmit the earthquake forces to the foundation by the aid of concrete walls or frames. On both sides of the corridors are the wooden floors of the classrooms, which transmit the earthquake loads.) The constant depth of the concrete slab (that is, the width of the corridor) is 12.0 ft, so that $\gamma = 12.0$.

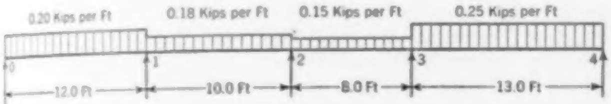

FIG. 2. LOADING ASSUMED IN NUMERICAL EXAMPLE

Assuming $\nu = 2.8$ and applying Eq. 8 in the same manner as in the standard analysis of continuous beams, the following simultaneous equations are derived:

$$
\begin{aligned}
+79.0\,M_1 - 10.2\,M_2 &= -131.5 \quad . \; . \; . \quad [10] \\
-10.2\,M_1 + 81.4\,M_2 - 17.2\,M_3 &= -\;\,64.5 \quad . \; . \; . \quad [11] \\
- 17.2\,M_2 + 82.8\,M_3 &= -157.2 \quad . \; . \; . \quad [12]
\end{aligned}
$$

Note that in Eqs. 10, 11, and 12 the elements of the diagonal (the coefficients 79.0, 81.4, and 82.8) are considerably greater than the remaining elements. Hence these equations can be solved conveniently by slide rule, if the method of iteration is applied.

Assuming $M_2 = 1.0$ in Eq. 10 and solving, $M_1 = -1.540$. Substituting this value in Eq. 11, and assuming $M_3 = 1.0$, $M_2 = -0.772$. Introducing the last value in Eq. 12 and solving, $M_3 = -2.070$. Using the values of M_2 and M_3 thus found, and proceeding in the same way as above, the second approximation gives $M_1 = -1.762$, $M_2 = -1.450$, and $M_3 = -2.210$. The third and fourth or final approximations are $M_1 = -1.852$, $M_2 = -1.491$, $M_3 = -2.220$, and $M_1 = -1.855$, $M_2 = -1.500$, $M_3 = -2.221$, respectively. The units are kip-feet.

Neglecting the influence of the shearing deformation—that is, applying the standard three-moment equation—we obtain:

$$
\begin{aligned}
44.0\,M_1 + 10.0\,M_2 &= -131.5 \\
10.0\,M_1 + 36.0\,M_2 + \;\,8.0\,M_3 &= -\;\,64.5 \\
8.0\,M_2 + 42.0\,M_3 &= -157.2
\end{aligned}
$$

Solving these equations simultaneously, the moments over the supports will be $M_1 = -2.962$ kip-ft, $M_2 = -0.1298$ kip-ft, and $M_3 = -3.738$ kip-ft. For reasons previously stated, the method of iteration cannot be applied in the solution of these equations.

Comparing the two sets of values for the moments over the supports, it is readily seen that the influence of shearing deformation is considerable.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Stereoscopic Mapping in Brazos River Region

TO THE EDITOR: The following facts may be of interest in connection with the article on "Air-Mapping the Brazos River Area" by Eric Haquinius, M. Am. Soc. C.E., in the July issue. Upon the granting of a federal allotment to the Brazos River Conservation and Reclamation District for the purpose of carrying out the proposed developments, the directors of this District requested the State Board of Water Engineers to continue its work of formulating plans for the proposed developments, until such time as the District could get its engineering force organized and functioning.

For the purpose of making plans and estimates of the proposed developments, this Board, in cooperation with the U. S. Geological Survey, had previously mapped all the proposed major reservoir areas on a scale of 1:48,000 with a contour interval of 20 ft.

It was considered advisable that the District should first map accurately, on a larger scale and in more detail, the several reservoir areas, as such maps were needed for making final plans and estimates, final surveys of the reservoir area to be purchased, and various other uses. Since the most improved modern mapping methods require the use of aerial photographs, the first step taken was to draw up specifications and secure bids for aerial photographs. Major Haquinius and G. C. Morris were put in charge of the work of securing the necessary aerial photographs.

By the time the first photographs were delivered the Brazos District had perfected its engineering organization. After thorough studies and investigations, it was decided that maps of the required accuracy could be more quickly and economically obtained through the method of stereoscopic plotting. In his article Major Haquinius discussed the organization, execution, accuracy, and cost of the work. The satisfactory results obtained show the value of the method chosen for carrying out the mapping program.

Under cooperative agreements between the U. S. Geological Survey and the State Board of Water Engineers an area of about 7,750 sq miles was topographically mapped on a scale of 1:48,000, with contour intervals of 10 and 20 ft. This work was done over the period from 1923 to 1931. The average cost of 5,568 sq miles of this mapping was $54.20 per sq mile, which amounted to a cost to the state of only $27.10 per sq mile. It was found that a material reduction in cost was obtained in mapping when aerial photographs, made by the U. S. Army, were used. These maps served well the purposes for which they were intended, as they enabled the Board of Water Engineers to make studies of various reservoir areas and estimates of cost and to formulate plans for the development of most of the major watersheds.

As a result of these studies, there have been organized river districts or authorities on most of the major watersheds of Texas. Before final plans and estimates can be made and construction begun, it will be necessary to have larger and more detailed maps covering various reservoir areas. Maps similar to those being made for the Brazos District would be adequate. Such maps could also be used for geological and agricultural studies, delineation of drainage areas, preliminary studies of highway locations, industrial locations, forestry studies, soil erosion studies, and many other uses.

By means of these modern methods, large-scale, detailed mapping

may now be done at such a slight additional cost over that for the smaller scale maps, that it would seem advisable for future mapping to be done on such a scale and with such detail.

There is now urgent need for such maps as are being made by the Brazos District, for all the various purposes just mentioned. It is highly important that a program, for carrying on such mapping work and for prorating the costs thereof between various agencies in proportion to the benefits to be derived therefrom, be worked out. The many uses that can be made of such maps and of the aerial photographs obtained in the process of mapping, and the rapidity and accuracy with which such work can be done, should give impetus to an extensive mapping program.

JOHN W. PRITCHETT, Assoc. M. Am. Soc. C.E.
Member, Texas State Board of Water Engineers

Austin, Tex.
August 22, 1937

More About Past-President Flad

TO THE EDITOR: In connection with your biographical sketch, in the July issue, about my father, the late Henry Flad, Past-President Am. Soc. C.E., these personal recollections may be of interest.

Father and I were always close friends. We romped together when I was a little lad. I visualize him sitting in his easy chair with his legs crossed, perching me on his foot, and holding both of my hands, then tossing me up and down repeating the German stanza:

"Hippity Hippity Hop
Das Pferdchen lauft Gallop
Hippity hippity hep
Das Pferdchen lauft geweg,
Der Reiter liegt im dreck."

Thereupon he suddenly lowered his foot, and I sprawled on the floor in great glee.

When we were children father was wont to repeat a few German proverbs time and time again, so that they became firmly instilled. I have always thought they influenced our behavior in after life. There was, for instance, the following:

"Ver einmal lügt, dem glaubt man nicht,
Und ven er auch die Warheit spricht.

"Wer lügt, der stielt, der senkt, der brennt,
Und wird zuletzt auf den Galgen gehengt."

In later years he seemed to enjoy telling me about his inventions and discussing engineering problems. I helped him in making experiments with the velocimeter for measuring the flow of water in pipes, with the rheobathometer for deep-sea soundings, with filters for the Mississippi River water, with timber preservation, and with the experimental dredge which he designed for the Mississippi River Commission. He was always very appreciative of my help and encouraged me to feel that I grasped his ideas more quickly than some of his engineering friends.

His spirit still motivates my actions and leaves me with an easy conscience so long as I follow its dictates.

EDWARD FLAD, M. Am. Soc. C.E.
Consulting Engineer

St. Louis, Mo.
September 7, 1937

"Trend Toward Trade Unionism"

DEAR SIR: As the largest national trade union in the technical field, may we be permitted to discuss, in your columns, the address made by President Louis C. Hill at the recent Society Convention, a digest of which was printed in your September issue, and to present the engineer employees' side of the trade union question, as we see it.

In the first place, permit us to take issue with the statement that "this trend towards trade unionism, if permitted to continue, will destroy whatever standing the engineer has obtained as a member of an acknowledged profession" and "that it will destroy public confidence in us as members of a true profession." We fail to see how the banding together of technical men for their economic betterment necessarily implies a lowering of their professional standards or a weakening of their professional ambitions. Surely a well-paid employee engineer, one whose salary is commensurate with the value of the services he renders, will be no less an asset to the profession by reason of that fact. Is it not far more reasonable to assume that such a recognition of his worth will tend to inspire in him a greater interest in his profession and to elevate his professional standing in the eyes of the public? Otherwise, just what do we mean by that term "professional standing"?

The important point at issue is whether such an end can best be attained through collective bargaining of employee groups through their own trade union, or by means of some such method as is outlined by President Hill in his address, or the tentative plan suggested by Mr. Van Tuyl Boughton, also reported in your September issue.

We feel that the plans suggested by both are woefully inadequate to meet the issue except, possibly, on an extremely limited scale. President Hill believes that the remedy lies in *individual* action by engineer employer members of the Society, in a voluntary effort on their part to "sell" their superiors or employers on the importance of the work of their employees and the justice of greater monetary rewards for that work. But President Hill's proposal, as outlined in his address, is dependent upon so many *"ifs"* as to destroy any confidence employees as a group may have in its adoption by any appreciable number of engineer employers.

Mr. Boughton would have the Local Sections of the Society interest themselves in the work of adjusting grievances of employee engineers, both monetary and others. He even suggests that "they could set up grievance committees to take up the troubles of the young men when they feel they are underpaid or overworked—committees that would go directly to their employers when sure of their ground." This is a consummation devoutly to be wished for, and by no one more than by us. Were engineering employees everywhere assured of such full cooperation from the Society as would result in the accomplishment of their objectives, then, truly, would there be little need for a union in, at least, this field of engineering.

But, is the Society ready to assume such a responsibility with all the burdensome and, may we add, often unpleasant work that this entails? Will the members of the Local Sections be willing to contribute their time and efforts to the performance of these duties? Will they, in effect, perform the functions of a trade union for engineer employees? We must leave this to the Society to determine.

What will the Society do in the case of leading executives who, although members of the Founder Societies, are carrying through ruthless and inhuman labor policies, which have shocked the conscience of the nation? The findings of the LaFollette Senate Investigating Committee are replete with the names of large and powerful industrial corporations who have resorted to the use of labor spies, blacklisting, and open violence in dealing with their employees (technical as well as production) who have organized peacefully in the American way to petition for a redress of their grievances.

The list is too numerous to mention, but may we refer to the Ford Motor Company, Remington-Rand, Bethlehem Steel, Republic Steel, Chrysler Motor Company, etc.

It is our feeling and we are gaining more and more support from day to day, that the employee engineer can achieve a recognition of his worth and bring about an amelioration of his conditions through collective bargaining carried on by his freely chosen trade union.

We consider the interest that the Society is taking in the economic betterment of the 90 per cent of engineers, who are employees, as a very hopeful sign and we are looking forward with interest to the concrete steps the Society may take towards the attainment of that end.

This will be a benefit not only to himself and his fellow technicians, but will be a benefit to the nation in that professional standards will be improved and there will be more and more incentive for better, more productive services.

ROBERT MIFFLIN SENTMAN
National President, Federation of Architects, Engineers, Chemists, and Technicians
Affiliated with the C. I. O.

New York, N.Y.
September 17, 1937

SOCIETY AFFAIRS

Official and Semi-Official

Canadian Engineers at Boston

Many engineers attending the Fall Meeting will wear on their lapels a distinctive badge of gold, silver, or bronze, bearing the likeness of a beaver. This pin is the emblem of the Engineering Institute of Canada, whose members are joining with the Society in the activities at Boston on October 6–8. The gold badge designates a member; the silver, an associate; and the bronze, a junior or a student.

The Engineering Institute of Canada celebrated its fiftieth birthday just three months ago. Among its more than 5,000 members are some 300 residents of the United States, many of whom are members of the Society. It is interesting to note that the first president of the Institute, Thomas Coltrin Keefer, was also the eighteenth president of the American society.

Many interesting facts about the Institute are recorded in the "Semi-Centennial" number (June 1937) of the *Engineering Journal*, its official organ. The Institute came into being in 1887, and its charter received royal sanction the same year. Until 1918 it was known as the Canadian Society of Civil Engineers, but its by-laws made it clear that the term "civil" had reference to all types of engineering other than military. From the outset the organization showed a healthy growth; its original membership of 288 doubled in the first ten years, and in thirty years the membership had reached the three-thousand mark.

The first local branch was formed in Toronto in 1890, and today there are 25 such branches. In 1918 the name of the organization was changed to make it "more expressive of its aims and functions," the *Engineering Journal* (a monthly publication) was established, and a full-time secretary was appointed.

The Institute has long been active along professional as well as technical lines. In 1896 one of its committees was instrumental in drafting a "licensing law" that was enacted by Manitoba in 1896 and by Quebec in 1898. According to the *Engineering Journal*, these enactments did not prove altogether satisfactory in operation. However, further work on the subject was undertaken later, and the model act prepared and adopted by the Institute in 1919 became the basis of legislation since adopted in all but one of the Canadian provinces.

The Society is delighted to be able to return so soon the hospitality accorded its members at the Institute's semi-centennial celebration in June 1937.

Structural Research

Progress in structural design depends entirely on the better understanding of the phenomena governing the behavior of engineering structures, making it possible to substitute more exact engineering knowledge for the approximations that were considered sufficient in the past. Such knowledge is accumulated as the result of theoretical and experimental researches that are being conducted in many countries of the world and in the rapidly increasing number of colleges and industrial laboratories in the United States. Particularly noticeable is the expansion of the experimental work that has taken place during the last few years.

Besides the time-honored methods of simplified analytical stress determinations and the checking of the actual stress by strain-gage measurements, new and fruitful methods of attack are being used or developed. More exact methods are necessary to determine the stress in statically indeterminate structures. An entirely new field of stress analysis is being opened up by the introduction of stress concentration factors, in order to make it possible for the designer to determine the actual stress distribution.

Fatigue, impact, and creep tests are supplementing the work of the ordinary laboratories; small- and large-scale models are being used extensively; indirect methods of strain and stress measurements—as for instance the photoelastic method and the membrane analogy—have been added to the methods of direct strain measurement of the past; and the vibrator is being used in the laboratory as well as in the field. Fatigue researches are bringing out the importance of the exact knowledge of stress concentrations. Such tests of riveted and welded joints and girders, either by direct application of dynamic loads or by use of vibrators, represent only a few of the most recent investigations which are so important in gaining a better understanding of actual stress conditions.

This extensive theoretical and experimental work seems to suffer from lack of coordination and insufficient exchange of information concerning the work proposed or being done. The different testing programs in the field of structural research mentioned in connection with the symposium on Structural Application of Steel and Light-Weight Alloys, in Pittsburgh in October 1936, suggest the necessity for steps to be taken to remedy these conditions. The American Society of Civil Engineers which, by its very nature, is interested in promotion of engineering knowledge, is the most logical organization that could successfully undertake such a coordination. This cooperation between the many active research groups ultimately should result in a properly balanced research program, eliminating the considerable overlapping and unnecessary waste of personal efforts and increased cost to all concerned.

The Structural Division of the Society is organizing, as a part of the existing Committee on Fundamentals Controlling Structural Design, a Subcommittee on Structural Research. The purpose of this subcommittee is to collect data on the research programs that are being conducted and contemplated, and to serve as a correlation agency which may be available to every college or industrial organization interested in economical and efficient structural research.

These activities, leading as they often do to worth-while technical papers, thus have a bearing on the publication program of the Society. While having no authority in connection with the research projects themselves, the Committee on Publications is sympathetic to all efforts to make the outcome of research more readily available to engineers. It proposes to seek advice, working through the officers and committees of the Structural Division, including the Subcommittee on Structural Research, as to the publication of papers dealing with structural research. The final decision as to the advisability of having the papers published by the Society is the responsibility of the Committee on Publications.

The Subcommittee on Structural Research is a purely cooperative agency. Its work can be beneficial only to the extent that institutions and individuals charged with structural research will be willing to cooperate with it. The plea therefore is made that all those interested get in touch with the chairman of the committee, A. V. Karpov, 801 Gulf Building, Pittsburgh, Pa. Any information concerning structural research that is being carried on at present or contemplated in the near future, or any suggestions in this matter, will be very much appreciated.

Transactions, Volume 102

In comparatively few weeks another volume of technical papers will be ready to take its place in the series known as Transactions of the American Society of Civil Engineers. Complete sets of Transactions are rare indeed. Collectors find it extremely difficult to find copies of Volumes 1 to 14, for example.

The new volume, typical of the modern Transactions, contains 37 papers on subjects covering every branch of the civil engineering art. The theory of structures and the broad subject of hydraulics are well represented. The seasoned, practicing civil engineer will find in this volume the latest thought, assembled from all corners of the earth, on pile driving, sedimentation, wind stresses, reinforced

concrete, building frames, models, fluid turbulence, wire ropes, permeability, dam sites, engineering geology, underground water, effects of earth shock on structures, surveying, express highways, steel, and light-weight alloys.

For the first time, in this volume, members will have available the complete text of the notable address prepared by Louis C. Hill, President Am. Soc. C.E., and presented in his absence by Vice-President E. P. Lupfer, at the Detroit Convention of the Society in July 1937. A limited number of reprints were distributed at the meeting and an abstract was published in the September number of CIVIL ENGINEERING. Also, for the first time, will appear the professional memoirs of 105 members, who died during the year 1936–1937.

The mailing of this edition (14,900 copies) marks the culmination of active effort by the staff in the months of July and August. Publication of PROCEEDINGS customarily is suspended during the two warm-weather months, not only because serious reading by members is inclined to lag at that time, but because the editors are engrossed in proof-reading, correcting, collating, repaging, and otherwise preparing the annual TRANSACTIONS.

To members, of course, the worth of this volume is measured by an appraisal of the technical content of the single copy in their possession; but a wide-spread vote of approval is evident in the mailing statistics. For example, currently the TRANSACTIONS shipment weighs more than 21 tons. Of this total, about 40,000 lb is mailed within the boundaries of the continental United States and the distribution of the remaining 2,000 lb is roughly as follows (see 1937 Year Book, page 484): Alaska, Canada, and Newfoundland, 14 per cent; Mexico, Central America, West Indies, and Bermuda, 23 per cent; South America, 14 per cent; Europe, 19 per cent; Asia, 14 per cent; Africa, 2 per cent; and Australasia and Oceania, 14 per cent. Parenthetically, the distribution to eastern Asia is somewhat complicated at present by international disturbances, and is subject to delay or suspension.

The pressure of this work is felt, not only in the editorial department, but in the mailing department and in the general office, and its completion, on schedule time, is a source of relief as well as great satisfaction.

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Ninth District Convention Scheduled for October 14–15, 1937, at Dayton

OPERATION of flood-control structures and the progress of aerial mapping will be features of the Ninth District Convention of the Society, to be held at the Engineers' Club, Dayton, Ohio, on October 14–15, 1937.

The convention will be called to order at 10:00 a.m. on Thursday, October 14, by Dr. Bernard T. Schad, president of the Dayton Section. After an address of welcome by Hon. Charles Brennan, mayor of the city of Dayton, R. C. Gowdy, Vice-President of the Society, will preside. A paper on "Fifteen Years' Operation of Flood Control in the Miami Conservancy District," including rainfall and hydrologic studies, will then be read by C. H. Eiffert, M. Am. Soc. C.E., chief engineer of the District, and discussed by C. S. Bennett, M. Am. Soc. C.E., assistant chief engineer of the District, and by C. H. Paul, M. Am. Soc. C.E., consulting engineer. An official luncheon will be held at noon. The Thursday afternoon program will be featured by an inspection of Taylorsville Dam, the municipal airport, Englewood Dam, and the sewage disposal plant. A banquet, entertainment, and dance will take place in the evening.

On Friday morning an illustrated paper on "Aerial Photography and the Civil Engineer" will be presented by Capt. L. J. Rumaggi, chief of the aerial mapping unit, Air Corps Material Division, U. S. Engineer Corps. A Friday afternoon inspection trip will be made to Wilbur Wright Field, the world's largest aeronautical research laboratory. An interesting program for the ladies has been arranged, covering both days.

North Carolina Student Chapters Conference Held

A REGIONAL CONFERENCE of the Student Chapters in North Carolina was held on May 8, 1937, at the time of the meeting of the North Carolina Section of the Society. The meeting was held at the Washington Duke Hotel in Durham, N.C., and was attended by forty representatives from the University of North Carolina, North Carolina State College, and Duke University.

President M. A. Lyons of the North Carolina regional student conference called the meeting to order and explained the functioning of the conference which has been operating for several years. Ordinarily two conferences per year are held, but conflicts prevented the holding of a fall meeting in 1936.

The executive committee of the conference reported the following officers for the academic year 1937–1938:

President, W. A. Edwards (North Carolina State College)

Vice-President, E. F. Coffin (University of North Carolina)

Secretary-Treasurer, C. L. Lucas (Duke University)

Commander L. F. Bellinger, Vice-President of the Society, gave an illustrated lecture on his engineering experiences in the Corps of Civil Engineers of the Navy.

Announcement was made that the newly elected officers of the conference had already begun work for another joint meeting to be held in the fall of 1937 at Raleigh, N.C., and also reported plans for several joint inspection trips during the coming year. The meeting then adjourned for dinner.

In addition to the student conference, many Chapter representatives attended the morning meeting and a part of the afternoon session of the North Carolina Section.

President Hill Visits Panama Section

ON JULY 2, 1937, while his boat was going through the Canal, President Hill was the guest of the Panama Section. He arrived at Balboa, C.Z., in the morning and was met by E. P. Haw, president of the Section, who acted as his escort during his stay on the Pacific side of the Isthmus.

After being presented to Gov. C. S. Ridley, other Canal officials, and members of the Section, Mr. Hill was driven around Balboa. Later he was taken through Gaillard Cut on a launch, stopping for lunch on one of the dredges. At Gamboa he caught the afternoon train for Cristobal, where he boarded a ship which sailed in the late afternoon.

November Issue of Interest to Younger Men

IN CONNECTION with the plan for enabling each Student Chapter member in good standing to have the privilege of requesting a complimentary copy of the November issue of CIVIL ENGINEERING, that issue will carry a number of articles, items, and reports of special interest to younger engineers, in addition to its usual features.

Among the special features referred to is an editorial on the importance of broad engineering courses in colleges; a paper on present social conditions and future planning from the viewpoint of the engineer; two "Engineer's Notebook" articles abstracted from prize-winning theses on civil engineering subjects by members of Student Chapters; a talk to students of engineering prepared by a Director of the Society, and some suggestions for the conduct of Chapter activities prepared by the Society's Committee on Student Chapters; advice on good methods for locating work, by the

head of a personnel-counseling agency; reports for the school year 1936–1937 from over a hundred Student Chapters; and several other items.

It is hoped and believed that engineering students will find much of interest and of value in the November number, which is in a sense a special issue similar to that published in September 1936.

Past-President Hunter McDonald

HUNTER MCDONALD, Past-President of the Society, died at Nashville, Tenn., on August 24, 1937, after an illness of several weeks. He was 77 years of age, and in term of office was senior to all other living Past-Presidents.

Mr. McDonald was born at Winchester, Va., June 12, 1860. The first few years of his life were passed alternately under the Confederate and the Union flag, as that town, and even his own home, changed hands several times during the Civil War. He was graduated from Louisville Rugby School, and studied engineering for one year at Washington and Lee University. This completed his formal schooling, and in 1879 he began his engineering career as assistant engineer with the Louisville and Nashville Railroad. Within a few months, however, he entered the employ of the Nashville, Chattanooga and St. Louis Railway; and except for one brief interval he served that road continuously until his retirement in 1932. For 40 years he was its chief engineer.

HUNTER MCDONALD, 1860–1937

From 1899 to 1916 Mr. McDonald also served as real estate agent for the same company; and from 1918 to 1920, when the railroads were under federal control, there were added to his duties those of chief engineer of the Tennessee Central and the Birmingham and Northwestern.

In 1906 he was engineer in charge of the construction of Cummins Station, in Nashville. This station was the property of the Wholesale Merchants Warehouse Company, of which he continued as general manager for many years. In 1906 he was also a member of a special commission appointed by President Theodore Roosevelt for testing fuels and structural materials.

In 1916 he was vice-chairman of the Nashville Section, Engineering Association of the South, which prepared a brief presented to the President of the United States advocating the establishment of the nitrate plant and the power and navigation dams at Muscle Shoals, Ala. In 1919, he was representative for the Southern Region of the U. S. Railway Administration, on a joint committee with employees of the Maintenance of Way Department, in framing rules and working conditions for those employees.

Mr. McDonald was a past-president and honorary member of the American Railway Engineering Association; a past-president of the Engineering Association of the South; and a member of the Franklin Institute and the American Railway Bridge and Building Association. He entered the Society as a Junior in 1883, transferred to the grade of Member in 1888, and served as Director from 1903 through 1905, as Vice-President in 1910 and 1911, and as President in 1914.

Annual Convention Draws Record Publicity

PUBLICITY received for the Annual Convention held in Detroit, July 21–24, 1937, amounted to more than 3,600 column inches. This is the record mark for a general meeting of the Society since the new Publicity Department was organized in January 1936. Interpreted another way, this amount of space is equivalent to more than 25 full newspaper pages of copy.

In all, the Convention was reported in almost 500 separate stories, appearing in 295 newspapers published in 221 cities. Newspapers in 40 states are represented in the compilation. Of further interest is the fact that the Convention publicity appeared in newspapers published in the areas of 46 Local Sections. It is thus of value to civil engineers resident in those areas as well as in promoting a national public recognition of the work and civic value of the profession.

October "Proceedings" in Two Parts

ABOUT eight thousand members who are waiting for the October PROCEEDINGS to appear in its customary envelope may miss the fact that the paper-bound volumes of TRANSACTIONS are issued as Part 2 of PROCEEDINGS. The two parts are packed together in a strong cardboard carton, and will be issued on the regular date, October 15.

Those who have their TRANSACTIONS bound in cloth or half morrocco will receive the October PROCEEDINGS in its smaller envelope as usual, and their volumes of TRANSACTIONS in a separate carton later. Because of the extra time required to apply the cloth and half-morrocco bindings, volumes in these bindings are necessarily somewhat delayed. This work is progressing on schedule, however, and the volumes themselves are expected to be shipped some time in November.

Joint Committee on Land Surveys and Titles Formed by Society and American Bar Association

IN AN EFFORT to alleviate the present unwarranted repetitive costs of real estate transfer and to provide an adequate system of recording title and describing property, a Joint Committee on Land Surveys and Titles has been formed, consisting of members of the Society and of the American Bar Association. The Society members, who were appointed by William Bowie, chairman of the Division of Surveying and Mapping, include the following: Philip Kissam, Princeton, N.J., chairman; G. R. Copeland, Harrisburg, Pa.; H. W. Hemple, Washington, D.C.; A. H. Holt, Iowa City, Iowa.; C. B. Humphrey, Boston, Mass.; R. L. Sumwalt, Columbia, S.C.; W. C. Taylor, Schenectady, N.Y.; and S. S. Steinberg, College Park, Md.

The Bar Association committee was organized by R. G. Patton, chairman of the Real Property Division, at the request of Nathan William MacChesney, chairman of the Section of Real Property, Probate, and Trust Law. Dorr Viele was appointed chairman of the committee, under Mr. Patton, chairman ex officio, with the following additional members: Frank Auchter, Springfield, Mass.; Francis N. Balch, Boston, Mass.; Thomas P. de Graffenried, New York, N.Y.; Francis G. Goodale, Boston, Mass.; and Charles E. Houghton, Dedham, Mass.

The first meeting of the Joint Committee will be held in connection with the Fall Meeting of the Society in October at Boston. The committee will consider proper legislation to attain its aim and will recommend legislation according to its findings. Although still in process of organization, the committee has already been called upon to review proposed legislation for land registration in Pennsylvania. The preceding account of its formation was furnished by Philip Kissam, chairman.

FALL MEETING of the Society, October 6–8, 1937, at Boston, Mass.

Early Presidents of the Society

It is encouraging to note the increasing interest of readers in supplying photographs and personal anecdotes for this series of sketches. Such cooperation is sincerely appreciated. The next three sketches will deal with William Powell Shinn, Octave Chanute, and Mendes Cohen.

XIX. MAX JOSEPH BECKER, 1828–1896

President of the Society, 1889

IN SELECTING Max Joseph Becker as its President for 1889, the Society turned for the third time to that famous group of German émigrés who had fled to this country after the Rebellion of 1848. Previously, it will be recalled, Albert Fink and Henry Flad had occupied the same post.

Becker was a native of Coblenz. In 1848, at the age of 20, he passed the examinations for admission to service on the government railroad surveys, and went to work as "engineer's apprentice," or rodman, on the Cologne and Minden Railroad. But within a few months the surveys were interrupted by the Rebellion, and like Fink and Flad, young Becker aligned himself with the Republicans and took an active part in the conflict.

MAX JOSEPH BECKER
Nineteenth President of the Society

When the Rebellion collapsed, he took refuge with his comrades at arms in Switzerland. In the following years many of these men, singly or in small groups, made their way to the United States. Becker came over in company with Carl Schurz, landing in New York in 1850.

Opportunity was not exactly waiting at the dock when the ship came in. In fact, by the time she put in an appearance, Becker was thoroughly well acquainted with the wolf on the doorstep. His first years in the Land of Promise were a struggle to make a living, and he wandered from place to place, trying his hand at whatever offered in the way of employment. For a while he worked on surveys for a map-publishing house in Connecticut. Again, he did drafting work for an engraver. At one time he had a job on the staff of a German-language newspaper, the *Abendzeitung*. Between times there was less congenial work, or none at all.

He headed west, and in the winter of 1851–1852 went to work as a draftsman for the Steubenville and Indiana Railroad, at Steubenville, Ohio. This was his first real opportunity, and he made the most of it. His promotion was rapid, and he soon became a resident engineer on construction. But when the road was finished in 1854 he was again without a job.

This time, however, things went somewhat better. He found professional work to do from time to time, and he further bolstered his finances by making and publishing a map of Coshocton County, Ohio. In 1856 he entered the service of the state as resident engineer on the Ohio Canal.

That waterway, joining Cleveland on Lake Erie with Portsmouth on the Ohio, had been since 1827 an important factor in commerce with the West. During the forties it had earned some $400,000 annually in tolls. In the fifties, however, railroad competition cut rapidly into its income, and by 1858 its traffic had dropped to less than a quarter of its maximum volume.

No record is available of Becker's work on the canal, but it may be presumed that it consisted mainly of inspecting and repairing locks, of which there were many. At the first opportunity he left this employment, to become resident engineer on the Marietta and Cincinnati Railroad, a line that later became a part of the Baltimore and Ohio system.

During the presidential campaign of 1860, Becker was attracted to politics. He saw in the cause of Lincoln some of the ideals for which he had struggled unsuccessfully in his native land a dozen years before, and like Schurz and others of his fellow exiles he took up the Republican banner. Among the German people of southern Ohio he made an excellent campaigner, addressing their meetings in their own language.

Political reward followed, shortly after the change of administration, in the form of the postmastership at Portsmouth, Ohio. He held that position for a year or so, but its drudgery and red tape were scarcely suited to his taste, and in 1862 he went back to railroad work, on the line that was to join Steubenville with Pittsburgh.

The outstanding structure on this road was the bridge across the Ohio at Steubenville. From its construction dates the era of long-span truss bridges in America. The channel span was 320 ft long and 28 ft deep, with posts and top chords of cast-iron, and it was proportioned for a rolling load of 3,000 lb per ft of track, a considerable increase over the loads previously considered standard. The honor of designing this bridge belongs to J. H. Linville, M. Am. Soc C.E., but Becker, in charge in the field, must be credited for solving the difficult erection problems involved in its construction. (This bridge, it may be noted, was rebuilt by Becker after about 25 years of service.)

In 1867 he became chief engineer of the Steubenville and Indiana Railroad. The following year this line was consolidated with others, including the Pittsburgh and Steubenville, to form the Pittsburgh, Cincinnati, and St. Louis Railway Company. Back of this merger, and those that followed, was the Pennsylvania Railroad, of whose system these lines eventually became a part. Through all these combinations, Becker remained as chief engineer, until he at length had charge of the entire Pittsburgh, Cincinnati, Chicago, and St. Louis Railway.

His record of 30 years of service with these roads speaks for itself. Of the details little need be said, except to point out that on these lines, as elsewhere, the period was one not only of expansion but of rebuilding. The earlier lines had been constructed on primitive principles, and with little conception of their ultimate requirements. As Becker said, their builders had been largely ambitious youths, "with far more self-confidence and assurance than was warranted by their stock of knowledge," who "sallied forth with transits upon their shoulders, Henck's *Field Book*, in their pockets, and an abiding faith in Providence to help them out in a pinch." Further, the tracks "were of every conceivable pattern and shape," the cross-ties "were rough hewn and ill shaped," and ballast was "a luxury in which but few roads could afford to indulge." Switches and frogs, he continued, "were constructed as if with the special object to have their presence distinctly felt in passing over them, and I can say from personal experience that they answered that purpose remarkably well." Finally, the establishment of stations, repair shops, freight yards, and so forth "was generally deferred until the development of the traffic indicated their want."

All of this earlier jerry-building threw a tremendous load on the railroad engineers of post-Civil War days, and it is much to the credit of such men as Becker that by the eighties the hodge-podge they had inherited had been transformed into a highly standardized, well-coordinated, nation-wide transportation system.

With all his duties, Becker found time to join actively in professional affairs. For this sort of activity his geniality and wit especially fitted him. He was one of the 32 founders of the Engineers' Society of Western Pennsylvania (1880), seldom missed a meeting of that organization, and was its president in 1893. He contributed frequently to its *Proceedings*, and in this connection should be mentioned his paper on rail joints, which attracted attention not only in this country but abroad.

Nationally, Becker was not so well known, and when he was nominated for the presidency of the American Society of Civil Engineers, in the fall of 1888, many questioned the choice. It is said, however, that before his term was over "he had won all hearts, as he always did wherever he came in touch with people."

Becker continued as chief engineer of his road until a few months before his death. Then, as his health began to fail, he relinquished some of his duties, though he was retained as consulting engineer and real estate agent. He died on August 23, 1896.

Preview of Proceedings

By Harold T. Larsen, *Editor*

The October issue of "Proceedings" is an answer to civil engineers who have been looking for good papers on other than mathematical design problems. Aside from a very brief but excellent analytical paper on reinforced concrete design, there will be five papers on recommendations for building rock-fill dams, economics of river improvement, aeration tanks for activated sludge tanks, and transmission problems of a water-supply system.

The Design of Rock-Fill Dams

With the intention of correlating modern knowledge pertaining to the design of rock-fill dams, a paper on the subject, "The Design of Rock-Fill Dams," by J. D. Galloway, M. Am. Soc. C.E., is presented to the profession in the October issue of Proceedings. The author uses as his background all available information concerning twenty-nine dams of this type constructed in California,

General View of Salt Springs Dam—Downstream Face

Arizona, Utah, Montana, Kentucky, New Mexico, and Colorado since 1872. Special attention is given to experience on Bucks Dam on the Feather River, built 1926–1928, and on Salt Springs Dam built on the Mokelumne River in California in 1930. A good view of Salt Springs Dam is presented in the accompanying photograph. The height of this dam is 328 ft, the crest length 1,300 ft, and it contains more than $3^1/_8$ million cubic yards of material. Basic recommendations pertaining to the foundations for rock-fill dams, the nature of the rock, the dimensions of the loose rock-fill, settlement, the impervious element on the water face, the intermediate rubble cushion, and expansion joints, are offered. The paper concludes with a statement of the limiting conditions under which such dams should be built.

Economics of the Ohio River Improvement

In a paper entitled "Economics of the Ohio River Improvement," C. L. Hall, M. Am. Soc. C.E., has brought up to date the questions affecting the economics of water transportation on the Ohio River. Utilizing fully the opportunity offered in Proceedings for a complete exposition of the subject, Colonel Hall presents tabular matter in considerable detail to support his conclusions. The approach, form, and material used present a rational, fair, and carefully worked-out exposition of his viewpoint. This paper is thorough, free of non-essentials, but adequately inclusive. Its basic problem is involved in the answer to the question "Is the public compensated for the heavy national expenditure on the Ohio River Improvement?" Colonel Hall has determined commercial navigation costs as accurately as possible on a ton-mile basis for each class of freight. Government costs are analyzed on a ton-mile basis applicable to all classes of freight. The sum of these two costs is compared with rail rates for various commodities both analytically and graphically. From his studies supported by adequate data, Colonel Hall concludes that the public has been compensated for such expenditure and that this fact tends to become more and more evident every year.

Design of Reinforced Concrete in Torsion

A paper by Paul Andersen, Assoc. M. Am. Soc. C.E., entitled "Design of Reinforced Concrete in Torsion," is interesting and sound, and deals with a subject that has been grossly neglected by the engineering profession. Although this paper is brief and can therefore be read quickly, it contains the essentials for a lively discussion in this field. Essentially, the method described by the author involves an adroit application of the moment-distribution method, to the solution for torsional moments in structures.

Aeration Tanks for Activated Sludge Plants

At the meeting of the Society in New York, N.Y., on January 16, 1936, the Sanitary Engineering Division discussed the paper by S. W. Freese, M. Am. Soc. C.E., entitled "The Design of Aeration Tanks for the Activated Sludge Process." In the limited time available, only a small part of this paper could be read, and that necessarily only to a restricted small group of the membership. However, under the title, "Aeration Tanks for Activated Sludge Plants," Mr. Freese is now having an opportunity to state his problem completely for discussion by the many readers of Proceedings. An adequate preview of this paper was published as an abstract of the 1936 Annual Meeting in the March 1936 issue of Civil Engineering. Suffice it to say now that this should prove to be one of the more important papers defining the status of the art of designing activated sludge plants. In effect, it contains specification material, written interestingly, in narrative form.

Solution of Transmission Problems of a Water System

In an effort to simplify the complex problem of designing the transmission system for a water supply, Ellwood H. Aldrich, M. Am. Soc. C.E., has developed a rational method involving an expansion of graphical solutions first suggested in 1892 by the late John R. Freeman, Past-President and Hon. M. Am. Soc. C.E. The title of this paper is "Solution of Transmission Problems of a Water System." Mr. Aldrich has divided this complex problem into general cases involving the combination of head losses for: (1) a pipe connected in series; (2) pipe connected in parallel and in series; (3) "take-outs" and "put-ins"; (4) compound storage; (5) pipe connected in parallel with intermediate cross connections; and (6) pipe connected in grids. He then presents graphs and explanatory matter for the solution of each case and, finally, includes the complete solution of a perfectly general case, choosing for his example the water-distribution system solved by J. J. Doland, M. Am. Soc. C.E., in the October 1, 1936, issue of *Engineering News-Record.*

Discussions

Those who are following the discussion of current papers will find convenient the list that always appears on the second page of Proceedings.

Appointments of Society Representatives

George S. Davison, Past-President Am. Soc. C.E., has accepted an appointment to serve as a Society representative on the John Fritz Medal Board of Award to fill the vacancy caused by the death of Harrison P. Eddy, Past-President Am. Soc. C.E. His term will expire in October 1938.

R. D. Goodrich, M. Am. Soc. C.E., represented the Society at the semicentennial celebration of the University of Wyoming at Laramie, Wyo., June 6 to 8, 1937.

Edward P. Lupfer, M. Am. Soc. C.E., represented the Society on the occasion of the semicentennial celebration of the Engineering Institute of Canada, held in Montreal, Canada, June 15 to 18, 1937.

Robert Ridgway, Past-President and Hon. M. Am. Soc. C.E., and Ole Singstad, M. Am. Soc. C.E., served as alternates for Thaddeus Merriman and Ralph Budd, Members Am. Soc. C.E., respectively, at the meeting of the Hoover Medal Board of Award held in New York City on May 26, 1937.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Civil Service and Public Works

GOVERNMENT reorganization, including all of the ideas advanced for a Public Works Department, was left in the tangled mass of unfinished business by the first session of the Seventy-Fifth Congress. Council's staff had advised with the several committees on government reorganization and maintained close contact with those members of both houses of Congress who had to do with reorganization legislation. In this connection, Council made the following statement to the select committee on government reorganization of the United States Senate:

"Engineers believe that the President should have effective managerial authority over the executive branch of the federal government commensurate with his responsibility under the Constitution of the United States, but they are not as concerned with strengthening the executive as they are with the larger aim of strengthening the administrative management system of the United States as a whole. They . . . . urge reorganization under direction of the Chief Executive on the basis of standards set up by Congress to provide up-to-date management for whatever activities may be decided upon by the people.

"Engineers have for many years favored the use of the merit system in personnel administration, and they now endorse the idea of expanding civil service to cover all non-policy-determining positions. They recognize the civil service system as a valuable part of government management under a non-partisan Civil Service Commission, and urge salary adjustments throughout the service so that the government may attract and hold in a career service men and women of the highest character and ability. . . .Under such circumstances, engineers feel that direct appointments by the President should be reduced to a very small number of only the highest positions, and all other civilian positions should be filled by the heads of departments, without fixed term, through civil service with adequate tests to determine fitness.

"Engineers. . . .recommend the creation of a Public Works Department to which the President should be authorized to transfer such major engineering and construction work for government agencies as may be practicable. Engineers believe that a Public Works Department should be authorized to coordinate the design, construction, operation, and maintenance of all large-scale public works which are not incidental to the normal work of other departments, to act as an agent of other departments on engineering public works, to administer federal grants to national, state, and local agencies for construction purposes, and to gather information with regard to public works needs and standards throughout the nation. They believe that a relatively small staff could and should direct such work in the hands of engineers in private business throughout the United States, without confusion and waste or the loss of valuable time.

"Such reorganization should promote efficient government in all of its branches. . . .As a whole, it should be easier for the Chief Executive to formulate programs for submission to Congress; and the Congress should be able to give more intelligent consideration to legislation and reach less hurried decisions regarding appropriations. The service agencies could perform their work with more certainty, and the public could more readily comprehend the work of the government, more directly exercise that general control which should obtain under a popular government, and more easily transact business with the government's agencies."

Excerpts were included from resolutions by the American Society of Civil Engineers and the American Engineering Council's Assembly to the effect that both organizations would support "the enactment of suitable legislation designed to create a federal Department of Public Works, as proposed by the President of the United States, with definite provision for excluding the army engineers and their river and harbor work from this department."

Scientific Research Legislation

Technology is not responsible for the great depression of the thirties, or the unemployment of millions of people. This and many other intelligent statements with reference to science and technology have been made by Congressman Randolph of West Virginia in support of his bill H.R.7939 "to provide for the promotion of the general welfare in relation to the economic efforts flowing from scientific and technological developments" in the United States. It is based on the premise that we must continue to create new "capital outlets," that the chief source of such outlets is the development of new industries, and that scientific research is the foundation of the greater portion of our modern industries.

Copies of H.R.7939, with an unusually interesting explanation of its objectives, are being mailed to all of American Engineering Council's member societies, and it is suggested that engineers may find much to interest them in its provisions. One of the principal objectives is the stimulation of pure science as a foundation for applied science which is recognized as the greatest factor in the development of the resources of the nation. Even though they may not agree with Congressman Randolph's ideas, engineers have an opportunity to applaud his efforts to effect a national recognition of the true value of technology and to contribute criticisms as well as constructive suggestions to the advancement of that cause.

Washington, D.C.
September 1, 1937

News of Local Sections

Sacramento Section

The Sacramento Section held its regular monthly luncheon meetings during August. On August 3 there were 45 present to hear Frederick Q. Teichert, engineer and contractor, give an instructive talk on the subject of "Modern Adobe Building Construction." There were 63 at the meeting held on August 10. On this occasion Gordon L. Long, assistant bridge construction engineer for the California State Division of Highways, spoke on hydrographic investigations in connection with bridge design. At the meeting held on August 17, Jerald E. Christiansen, assistant irrigation engineer in the college of agriculture at the University of California, presented a paper on the characteristics of Pitot tubes. The talk was illustrated with slides. There were 54 present on August 24 to hear Owen G. Stanley, senior engineer in the U. S. Engineer Office at Sacramento, speak on "The Construction of Earth Levees." The session on August 31 was devoted to a discussion of Society affairs of interest to the Section. There were 33 present.

San Francisco Section

On August 17 the regular bimonthly meeting of the San Francisco Section took place with 140 members and guests in attendance. During the business session the resignation of Fred C. Scobey as vice-president of the Section, because of his continued non-residence, was accepted. The technical program included the showing of a talking motion picture entitled "Empire of the West." This film, which was shown through the courtesy of the Metropolitan Water District of Southern California, was concerned with the District's quest for water and the subsequent building of Parker Dam with its miles of aqueducts and tunnels. Following this, a film dealing with the modernization of rail transportation was shown through the courtesy of the General Electric Company. Preceding the showing of this film, L. W. Birch, transportation engineer of the Ohio Brass Company, gave a brief talk on the civil engineer's part in the modernization of rail transportation.

Tennessee Valley Section

The Asheville Sub-Section of the Tennessee Valley Section held its regular monthly meeting at the George Vanderbilt Hotel in Asheville on July 19. Since the occasion was "Ladies Night" there were 30 women among the 108 present. Entertainment on this occasion consisted of the showing of two films—one on the San Francisco-Oakland Bay Bridge Project, and the other on the work of the Tennessee Valley Authority. The former was shown through the courtesy of the American Bridge Company.

The August meeting of the Knoxville Sub-Section of the Tennessee Valley Section took the form of an inspection trip to the plant of the Fulton Sylphon Company in Knoxville. A number of the members enjoyed this interesting inspection trip.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for November

Aspects of flood control in various parts of New England will be discussed in a symposium scheduled for the November issue of Civil Engineering. The first of these, by H. K. Barrows, M. Am. Soc. C.E., professor of hydraulic engineering at the Massachusetts Institute of Technology and regional consultant to the National Resources Committee, outlines the recommendations of the Water Resources Committee for flood control in New England, compares them with the plans of the U. S. Engineer Corps for the Connecticut and Merrimack basins, and comments upon some features of the interstate compacts for these rivers now before the various state legislatures. The second paper, by Hugh J. Casey, M. Am. Soc. C.E., until recently executive officer for the Boston District, U. S. Engineer Corps, describes the studies made since March 1936 by the Corps for flood control on the principal Maine rivers and on the Merrimack in New Hampshire and Massachusetts. It is also hoped that a paper by Mason J. Young, M. Am. Soc. C.E., until recently executive officer in charge of the Providence District, U. S. Engineer Corps, will be received in time for inclusion. This paper will describe the plan of the Corps for flood control on the Connecticut River.

Foundation problems are attaining increased importance as modern structures increase in height, but unfortunately little is known about the strength, elasticity, or compressibility of rocks which contain clay seams or disintegrated parts. This is due largely to the fact that tests on rock samples removed from the site indicate only the probable behavior of the strongest elements, as pointed out by William O. Hotchkiss, M. Am. Soc. C.E., president of Rensselaer Polytechnic Institute, in an article on the overlapping fields of geology and civil engineering. Dr. Hotchkiss emphasizes the need for making such tests on rocks and unconsolidated materials without removing them, as the three-way stresses of the natural state cannot be duplicated in the laboratory. The paper also gives some basic data on the physical properties of rocks.

If space permits, an article on the manufacture of structural clay products, by F. E. Emery, M. Am. Soc. C.E., engineer-secretary of the Eastern Structural Clay Tile Association, Inc., will be included. Clay products have maintained a prominent place among building materials since very early times. In view of the wide use today of brick, tile, architectural terra cotta, and other structural burned-clay products, a general acquaintance with the various processes of manufacture is of value to the engineer. Mr. Emery's article gives a bird's-eye picture of this industry from pit to finished product.

A number of special features designed to appeal to younger engineers will also be incorporated in the November number. These include several articles and items of value to the engineering student and to the recent graduate.

Wise and Otherwise

The following problem has been transmitted to Professor Abercrombie by H. E. Phelps, M. Am. Soc. C.E. Three brides, Gretchen, Lisa, and Susan, went with their husbands, named (but not respectively) Peter, Jason, and Hans, to buy some pigs. Each person bought as many pigs as he or she paid shillings for each pig. Each husband paid a total of 63 shillings more than his wife paid. Hans bought 23 more pigs than Susan did, and Peter bought 11 more than Gretchen. How were the couples mated?

In September's problem a wagon-load of hay was moving towards a barn at a rate of 4 mph, when Professor Abercrombie observed an insect crawling round and round one of the wheels on the edge of the rim at a rate of 11 in. per sec. As the insect reached a point opposite the top of the wheel it could easily descry the barn, but this pleasing view did not cause any change in its speed. The question was to find how fast the insect was nearing the barn at that precise moment.

Since the translational velocity of a point on the top of the wheel is twice that of the axle, its instantaneous speed towards the barn is 8 mph. The insect's speed is 11 in. per sec, or $^5/_8$ mph. As we are told that the insect "could easily descry the barn," it must have been facing it. Its speed relative to the point on the top of the wheel (and, for the moment, horizontal) must be added to that of such point, and the insect is therefore approaching the barn at a speed of $8^5/_8$ mph. The problem is of interest in that the diameter of the wheel has no bearing on the solution, although it seems at first glance to be essential.

Suggestions for other problems for Professor Abercrombie's column, accompanied by solutions, may be addressed to the editor. Solutions should preferably be sent in separate enclosed envelopes.

Making Ends Meet on a Freeman Scholarship

By John Hedberg, Jun. Am. Soc. C.E.
Freeman Scholar, 1936–1937
and Ruth Hedberg

Mr. and Mrs. Hedberg returned from their year of travel and study in Europe on July 2, 1937. The following article is an abstract of an informal report prepared by them jointly in the interest of future Freeman Scholars and others planning to tour Europe on a limited budget.

We want to make clear that we are not writing a guide book or laying down hard and fast rules for getting along in Europe. What we do want to do is to point out a number of ways that we have learned, largely by trial and error, to stretch a very limited budget as far as possible without breaking it.

To begin, let us present our completed accounting of how the scholarship money of $1,600 has been spent during the year 1936–1937.

Passport and visas	$ 25.00
Two round-trip tickets third class—New York to Hamburg	348.00
Incidentals to ocean travel (both ways)	10.00
Food and lodging and miscellaneous for 301 days in Europe	918.00
6,635 miles of travel in Europe (two fares)	220.00
Available for New York to California return	79.00
	$1,600.00

If we were to start our journey again, there are a number of preparations that we would make. Some of these we actually did make; others we neglected or never knew about. First of all, it turned out entirely satisfactory as well as economical to have a joint passport instead of separate ones. Secondly, we never regretted our decision to travel light. We found it a great saving to have only as much luggage as we could handle without any assistance; a trunk is the world's

FALL MEETING of the Society, October 6–8, 1937, at Boston, Mass.

worst obstacle to economical traveling.

One of the most troublesome problems of preparation is the question of books. A few are indispensable of course—dictionaries and foreign-language grammars come first and a few technical handbooks next. We cut the load by eliminating travel literature as far as possible. From New York we took only a booklet which listed European hotels and pensions, and a single guide book, both very much worth while.

If one plans to go directly to Germany there are several matters worth attending to before leaving the United States. First, it is possible to obtain a 60-per cent reduction on railroad fares in Germany if border-to-border tickets are purchased outside of Germany with non-German currency. These tickets are good for three months and permit stopovers anywhere along the route. By careful planning of one's travel, considerable savings in railroad costs may be made. Incidentally, third-class facilities are perfectly satisfactory almost everywhere in Europe. Another matter of great importance is the purchase of "registered marks." One may obtain these at banks or travel bureaus outside of Germany, and they represent an enormous saving over the exchange by the normal rates. They are not obtainable within Germany except through arrangements that must be made through some outside bank.

Against the advice of all our friends we bought round-trip steamship tickets third class. Imagine our surprise to find the facilities and entertainment very good! The food was excellent; we had plenty of deck space and lots of room for exercise and lounging; and the informality of dress was a comfort to us with our meager supply of clothes. Our fellow travelers were middle-class people, and included quite a group of students.

The problem of finding economical and comfortable places to stay in European cities is really not as difficult as in America. We found it almost invariably true that in the neighborhood of the central stations of the German cities exist many small hotels or rooming houses that are always clean and neat, although their facilities vary. We rarely had to pay more than 5 or 6 marks for a double room with hot and cold running water and central heating, with breakfast also thrown in.

Our system of travel was based on short runs of not over 4 or 5 hours (if we could help it); arrival at our destination in the early afternoon; guarding of the luggage by the wife in the station; and the hunting of a place to stay by the husband. In the largest cities of Europe and a few of the smaller places, this system does not work so well because of the greater distances to the cheaper areas. In Berlin, where we planned to make a long stay, we found it advisable to consult the Berlin Official Tourist Association. This organization had a large list of private pensions distributed over the whole city in a wide range of prices. All we had to do was to suggest a price and a district and the office girl was ready to compile a list and telephone to the houses to see if there were vacancies. We take off our hats to this organization and its workers for their excellent demonstration of characteristic German efficiency and politeness.

Travelers in Europe that we have met have been unanimous in the opinion that London is one of the most expensive cities for travelers. We found it so also, and we are agreed that it was pure luck that we stumbled on a certain hotel near the Victoria Station where we obtained a small room with running water and central heating for 7½ shillings a day, including breakfast. The room was definitely not as clean or as neatly furnished as we had been getting in Germany, but the breakfasts were superlatively excellent.

Paris was literally filled with cheap hotels but the difficulty we had was to find one that was both clean and quiet. However our third try proved to be a jewel. We had here a nice large room, well furnished, with excellent heat, and water very consistently hot, for the excellent price of 100 francs a week.

The $100 a month stipend—after the first month, which is $500—forms the material from which a budget must be carved. Naturally, food and lodging have the first call and will take about 70 per cent of it. The remainder is the battle ground between a host of miscellaneous items and what one wishes to save for traveling. Here is how we drew the line between them.

Month	Food and Lodging	Miscellaneous	Saved for Travel
August . . .	$ 11	$ 2	$124*
September . .	66	18	16
October . . .	72	16	12
November . .	74	10	16
December . .	82	18	0
January . . .	65	14	21
February . .	68	12	20
March . . .	70	8	22
April	87	12	1
May	93	29	−22
June	60	30	10
Totals . .	$748	$160	$220

* Saved from original $500.

Traveling expenses on the Continent may be summarized as follows:

Country	Miles of Travel	Cost of Travel (Two Persons)
Germany . . .	2,200	$ 56.31
Switzerland . .	122	6.69
Holland	143	6.68
Belgium	105	4.94
England	214	32.00
France	692	22.00
Italy	1,056	10.50
Austria	393	10.40
Czechoslovakia .	208	7.90
Denmark . . .	300	15.20
Sweden	642	23.42
Norway	560	24.00
Totals . . .	6,635	$220.04

There are many peculiarities about these figures that need explaining. For example, traveling over a thousand miles in Italy for $10.50 for two persons seems incredible until it is known that we received a 70-per cent reduction on tickets to and from an exposition at the Vatican. We also obtained an 80-per cent reduction on tickets to and from Vienna, 30 per cent on border-to-border tickets in Switzerland, and 30 per cent on a Scandinavian loop ticket. It always paid to ask before buying tickets whether or not cheap excursion tickets were available, for unless one asks for them one probably will not get them. All our rail travel was third class, yet entirely satisfactory. One es-

THE TRAVELING FREEMAN SCHOLAR FINDS MANY INTERESTING STRUCTURES ON EUROPEAN RIVERS
Left, the Bridge of Boats, at Coblenz; Right, Weir and Locks on the Neckar Canal at Heidelberg

pecially economical feature of third class accommodations is that a box lunch can be carried without embarrassment.

There are just three ways to handle the food problem: arrange for full board and lodging, frequent restaurants, or prepare one's own food. The first is the easiest, and is especially convenient when the language is strange. However it is generally more expensive and inclined to become monotonous. The second is much more interesting but sometimes is the most expensive. We never attempted to prepare all our food. That probably would have been very economical but certainly not convenient when one is on the move. We did however successfully arrange to buy the makings for cold suppers and, combining them with substantial hot meals in a restaurant at noon time, managed not only to balance our diet but also to make a very good impression on our budget. This was really our big money-saving policy. Whenever we needed to save the carfare for some long trip, we could depend on doing so by this method. It might seem that breakfast would be a good meal to prepare for oneself, but it happens that there is something of a code in Europe that requires one to buy one's breakfast at the hotel or lodging house where one lives; in any case it is an expected gesture of politeness to do so.

One of the most troublesome problems was finding the most advantageous way of changing our money. If one learns by his mistakes we should have learned plenty, because we never made anything but mistakes. We have just about concluded that in the money-changing game the tourist always loses. When we received our first check for $100 and took American currency in cashing it, we got poorer exchange rates in our cash than we would have obtained from the check itself. We learned that it was better to avoid American currency entirely. Then we discovered that small change depreciated enormously when taken over borders. We found out also that it was a good idea to shop around on exchange rates, because banks were usually better than the travel agencies. In general we tried to make as few exchanges as possible by estimating the amount of money needed in each currency.

In concluding our report on finances, we wish to emphasize our belief that the Freeman Scholarship is entirely adequate for two persons—though we must confess that much of our success is chargeable to luck rather than to good management. Here's hoping that our successors have an equal measure of good fortune.

Outstanding Features of New Building Code for New York

A new building code for New York City, replacing one that has been in effect since 1916, was adopted by the board of aldermen on July 20, 1937, and will go into operation on January 1, 1938. The following summary of its outstanding features has been prepared for "Civil Engineering" by Richard A. Backus, M. Am. Soc. C.E.

Responsibility Placed for Safe Design and Construction—An affidavit must be filed by a licensed architect or engineer when filing plans for any structure affecting public health or safety, stating that he has supervised the preparation of the plans, and that, if built in accordance with the plans, the structure will conform to the Building Code and to other laws applicable thereto.

Also, an affidavit must be filed by the licensed engineer or architect, or superintendent of construction, who supervised the construction, when applying for a certificate of occupancy. This affidavit must state that the structure has been erected in accordance with the plans and, as erected, complies with the laws governing such construction.

New Classification for Buildings—The new code provides for a new type of construction known as Class II, Fire-protected Structures, in which all structural members are of metal or masonry, and in which 3-hour protection is required for exterior walls, shafts, stairway enclosures, and for structural members carrying walls. Floor construction immediately above the cellar or basement is to be of 3-hour protective construction, but other floors and the roof may have $1^1/_2$-hour protection. For interior columns in residence buildings, 2-hour protection is to be provided.

Class II is primarily to provide a safe and cheaper construction for apartment buildings up to 100 ft (9 stories) in height. By the old code, all residence buildings over 6 stories in height had to be of the 3- and 4-hour fireproof construction.

Class VI, Heavy Timber Structures, is recognized as a desirable type of construction and is allowed for commercial buildings up to 65 ft (5 stories) in height and for residence buildings up to 75 ft (6 stories).

Welding Permitted—Structural welding is permitted if done by a person passing qualifying tests conducted by an "Examing Board for Welders" and obtaining from them a certificate attesting to fitness. Specifications of the American Welding Society governing methods and working stresses are generally followed in the new code. Restricted gas-cutting of structural steel is permitted.

Revised Stresses and Live Loads—Space does not permit a detailed discussion of the changes in working stresses and loadings. However, the following general remarks will indicate their nature. Higher working stresses are allowed for structural steel and definite stresses are given for silicon and nickel steel. Stresses for ordinary concrete are retained, but higher stresses are allowed for "controlled concrete" when used under a required supervision. New formulas are given for two-way reinforced-concrete slab design. Masonry working stresses are generally increased. Live-load requirements have been revised in some cases and are generally slightly less than by the present code.

Some time before the first of the year copies of the new code will go on sale at the City Record, Municipal Building, New York, N.Y. The price has not yet been set.

Brief Notes from Here and There

ENGINEERS engaged in preparing or revising local building codes will be interested in the list of source material on that subject recently prepared by the American Standards Association. The bibliography consists of 12 mimeographed pages, and includes some 80 items available from responsible organizations. It has been compiled by the Building Code Correlating Committee of the Association, in cooperation with the National Bureau of Standards. Copies can be secured, without charge, on application to the Association, at 29 West 39th Street, New York, N.Y.

* * * *

THE AMERICAN Welding Society has recently issued a bulletin entitled "Welding Symbols and Instructions for Their Use," containing revised standard welding symbols for both fusion and resistance welding. These symbols provide a means for placing complete welding information on working drawings, as they show graphically the type of weld required. Copies of the bulletin may be obtained from the American Welding Society, 33 West 39th Street, New York, N.Y., at 25 cents apiece.

* * * *

WHAT IS the most suitable structural and architectural design for an elevated highway to be built over an existing thoroughfare? The American Institute of Steel Construction has announced a nation-wide design competition to find out, and will pay a total of $9,000 in prizes to the winners, including a first prize of $5,000. Details of the competition, which closes March 31, 1938, can be secured from the sponsors, at 200 Madison Avenue, New York, N.Y.

* * * *

INTELLIGENT altruism on a huge scale is graphically indicated by the Report of the Rockefeller Foundation for 1936, recently released. Limitless possibilities are envisaged in the charter of the Foundation, which was written in 1913 and proposes "to promote the well-being of mankind throughout the world." It is not strange, therefore, that a very broad distribution of activity is possible, including the medical, natural, and social sciences, and the humanities among others. Of particular interest to engineers is the advanced work

in public health, which received almost two and one-half millions out of a total of $11,300,000 appropriated during 1936. Outstanding in this field is the work on yellow fever, malaria, and influenza. The Foundation's report, which is written by President Raymond D. Fosdick, constitutes an interesting account of modern enlightened philanthropy.

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TESTS to measure "engineering horse-sense" in incoming students have been adopted by the Cooper Union Engineering Schools, it is announced by Dean George F. Bateman. The tests will be included experimentally in the competitive "aptitude examination" to be taken in the fall by more than 2,000 applicants. While the "horse-sense" tests will have no bearing on the success or failure of the candidates this year, the results will be used as a guide for devising future quizzes, taking into account inherent fitness for the engineering profession as well as intellectual aptitude. It is hoped that by thus improving the method of selecting students, the academic casualty rate can be reduced.

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THE FLOODS of March 1936 in Pennsylvania are analyzed in detail in a 129-page report of that title, prepared by the Department of Forests and Waters of Pennsylvania in cooperation with the U. S. Geological Survey. The report contains a wealth of basic hydrologic data, including precipitation records and gage-height and discharge hydrographs and tables.

• • • •

A BOOKLET entitled "Recommended Safeguards for Flammable Liquids Storage Tanks in Regions Subject to Floods" has been published by the National Board of Fire Underwriters, 85 John Street, New York, N.Y. It includes a set of recommendations suitable for adoption as an ordinance by communities in which the problem is of importance.

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A 14-PAGE pamphlet giving definitions and analyses of ferro-alloys and various classes of pig iron has just been published by the American Iron and Steel Institute. It comprises Section 1 of a projected "Steel Products Manual," of which other sections are proposed to be issued from time to time covering other major classes of products; manufacturing tolerances; methods of inspection, sampling, and analysis; and so forth. Copies of the pamphlet can be secured from the Institute, at 350 Fifth Avenue, New York, N.Y., at 15 cents each. The price is less for bulk orders.

NEWS OF ENGINEERS

Personal Items About Society Members

GEORGE M. RAPP, formerly assistant engineer for the Port of New York Authority, is now chief engineer of the Pittsburgh-Corning Corporation at Pittsburgh, Pa.

FRANCIS L. BROWN was recently appointed county superintendent of highways for Washington County, New York, with headquarters at Hudson Falls, N.Y. Mr. Brown was seventh on the list in the recent examination of 745 candidates for a commission as lieutenant (jg), C.E.C., U. S. Navy.

T. S. O'CONNELL, state highway engineer of Phoenix, Ariz., has been appointed chairman of the committee on international highway relations of the American Association of State Highway Officials.

HUGH MILLER has opened an office in the Great Kanawha Building, Charleston, W. Va., for the general practice of engineering, architecture, landscape architecture, and town, city, and industrial planning. He was formerly chief engineer for the PWA in West Virginia.

MILTON DUBIN, previously structural engineer for the city of New Rochelle, N.Y., has been appointed a junior materials engineer in the engineering mechanics section of the National Bureau of Standards. His headquarters are in Washington, D.C.

O. H. AMMANN has been appointed to fill the newly created post of director of engineering for the Port of New York Authority. Mr. Ammann, who was formerly chief engineer of this organization, has designed some of the world's most notable bridge structures, including the George Washington Bridge and the Triborough Bridge.

A. N. MURRAY has resigned as chief of party for the Metropolitan Water District of Southern California, at Rice, Calif., to take a position as construction engineer with the Morrison-Utah-General Company at Keystone Dam, Ogallala, Nebr.

JAMES G. WOODBURN is assuming his new duties as professor of hydraulic engineering at the University of Wisconsin this fall. He was previously associate professor of hydraulic engineering at the State College of Washington.

ROBERT J. ROSS has been promoted from the position of assistant city engineer of Hartford, Conn., to that of city engineer.

CARL E. BURLESON, who for the past twenty years has been engineer of Pinellas County, Florida, with headquarters at Clearwater, recently established a private practice.

CHRISTOPHER E. SHERMAN, professor of civil engineering at Ohio State University, has been appointed first chief engineer of the Scioto-Sandusky Conservancy District.

PHILLIPS B. MOTLEY recently retired as engineer of bridges for the Canadian Pacific Railway after forty-five years of service with the company.

W. A. D. WURTS, formerly sanitary engineer for the Metropolitan District Commission of Hartford, Conn., has been appointed assistant city engineer of Hartford.

CHARLES R. HAILE has opened a consulting engineering office in Houston, Tex. Previously he was county engineer for Harris County.

ARCHIBALD L. PARSONS, who is in the Civil Engineer Corps of the U. S. Navy, has been promoted from the rank of captain to that of rear-admiral. He is now serving as public works officer at the Brooklyn Navy Yard.

JAMES R. POLLOCK was recently appointed city manager of Flint, Mich. Previously Mr. Pollock was director of public works and utilities for the city.

FRANK S. BESSON, JR., lieutenant, Corps of Engineers, U. S. Army, has been transferred from Washington, D.C., to Galveston, Tex., where he will be district engineer.

OTTO F. THEIMER is now chief engineer of Suka-Silo-Bau, Munich, Germany. He formerly had a consulting engineering practice in Brno, Czechoslovakia.

ROBERT T. REGESTER, previously chief designing engineer on the new sewage-treatment works at Columbus, Ohio, has recently become associated with Whitman, Requardt, and Smith, consulting engineers of Baltimore, Md., in connection with extensive sewage-treatment facilities being designed by the firm for that city.

N. N. PAPANDREA, junior member of the firm of Freeman and Winston, civil and consulting engineers of West Orange, N. J., has been appointed resident engineer of Graceland Memorial Park, Kenilworth, N.J.

ROBERT E. HILES has accepted a position with the Ingalls Iron Works, with headquarters in Birmingham, Ala.

HAROLD E. WESSMAN, associate professor of structural engineering and mechanics at the University of Iowa, has accepted an appointment as professor of structural engineering in the college of engineering at New York University.

JAMES E. AKANS, formerly engineering aide for the Tennessee Valley Authority, has been appointed junior highway engineer in the Highway and Railroad Division of the Authority. His headquarters are still in Chattanooga, Tenn.

GEORGE V. LONG is now sanitary engineer for the Henry County (Ohio) District Board of Health, with headquarters at Napoleon, Ohio. He was formerly assistant field engineer in charge of the WPA for Coshocton County, Ohio.

GEORGE F. GAGON, who was in the engineering department of the Boeing Aircraft Company, Seattle, Wash., has entered the

employ of the U. S. Bureau of Reclamation as a concrete inspector at Coulee Dam, Wash.

John Morton Billing has been promoted from the position of assistant water engineer in the Public Works Department of Singapore, Straits Settlements, to that of executive engineer in the same department.

George S. Knapp, chief engineer of the Division of Water Resources of Kansas, has been granted a six-month leave of absence to act as technical adviser to the newly created North Dakota Water Conservation Commission. He will be located at Bismarck, N.Dak., for this period.

Charles E. Morgan, former assistant highway engineer in the Illinois State Division of Highways, has accepted a position as structural engineer in the Chicago office of the Portland Cement Association.

Frank Cardile has been appointed to the position of junior engineer in the U. S. Bureau of Standards, with headquarters in Washington, D.C.

M. P. Anderson, previously an assistant engineer for the Mason-Walsh-Atkinson-Kier Company on the construction of Grand Coulee Dam, is now chief engineer for Brown and Root Inc., and the McKenzie Construction Company, of Austin, Tex., contractors on the construction of Marshall Ford Dam.

Ronald B. Wills has been promoted from the position of engineer of highway planning in the Kansas State Highway Commission to that of engineer of design.

Charles L. Barker, formerly instructor in mathematics and mechanics at the University of Minnesota, has received an appointment as assistant professor of hydraulic engineering at the State College of Washington.

Hugh J. Casey, captain, Corps of Engineers, U. S. Army, has been transferred from Boston, Mass., to Manila, Philippine Islands, where he will be engaged in a special hydroelectric survey and construction project for the Philippine government.

Leo N. Komiakoff is now an engineering inspector for the New York City Board of Water Supply, with headquarters in Newburgh, N.Y. He was previously senior foreman in the National Park Service, with headquarters in Port Jervis, N.Y.

Paul G. Martin has been promoted from the position of assistant office bridge engineer of the Kansas State Highway Commission to that of bridge engineer.

Julian Montgomery has resigned as Texas state director of the PWA to become state highway engineer of Texas.

Fred J. Benson, formerly an instructor in the civil engineering department of Purdue University, has accepted a similar position at the Agricultural and Mechanical College of Texas.

R. L. Peurifoy recently established the consulting engineering firm of Peurifoy and Patterson at Kingsville, Tex. He will also retain his position as professor of civil engineering and director of the school of engineering at the Texas College of Arts and Industries.

Don Lee is now connected with the Talco Asphalt and Refining Company, at Mount Pleasant, Tex. He was previously executive secretary of the Texas Highway Branch of the Associated General Contractors.

Gerard A. Rohlich is now an instructor in civil engineering at the Carnegie Institute of Technology.

H. Austill has been promoted from the position of bridge engineer for the Mobile and Ohio Railroad Company to that of chief engineer. His headquarters are in St. Louis, Mo.

F. D. P. Bruner, formerly an assistant civil engineer for the Resettlement Administration, has accepted an engineering position with Slaughter, Saville, and Blackburn, Inc., of Richmond, Va.

Samuel R. Wright is now in the civil engineering department of the Agricultural and Mechanical College of Texas. He was formerly utility engineer for the city of Fort Worth, Tex.

John S. Leister has left the University of Alabama, where he was assistant professor of civil engineering, to take a position in the civil engineering department at Pennsylvania State College.

Chad F. Calhoun, formerly chief engineer for MacDonald and Kahn, Ltd., of San Francisco, Calif., has left the service of that organization and announces the formation of the Calhoun Company, Inc., a general construction and engineering company, with headquarters in Los Angeles.

Robert H. Wood has resigned as bridge designer for the Mississippi State Highway Department to accept a position in the engineering department of the Virginia Bridge Company in Birmingham, Ala.

DECEASED

George Champe (M. '22) senior member of the civil engineering firm of Champe, Finkbeiner and Associates, of Toledo, Ohio, died in Chicago, Ill., on August 24, 1937. Mr. Champe, who was 69, was born in Dublin, Ind., and was educated at the University of Indiana. Following his graduation in 1893, he became city engineer of Bloomington, Ind. He remained in this position until 1900, with the exception of one year spent as assistant city engineer of Indianapolis, Ind. In 1900 Mr. Champe established his consulting practice in Toledo.

Joseph Malcolm Clapp (M. '08) consulting and contracting engineer of Seattle, Wash., died there on July 20, 1937, at the age of 71. Mr. Clapp was born in Ontario, Canada, and educated at the Royal Military College at Kingston, Canada. In 1890, after several years with the San Gabriel Rapid Transit Railway and the Southern Pacific Railway Company, he entered the U. S. Engineer Office, becoming assistant engineer at Portland, Ore. In 1895 he was made principal assistant engineer of the Seattle District, holding that position for fifteen years until he entered private practice. Mr. Clapp was instrumental in the construction of many important harbor and waterway projects in the Northwest, including the Lake Washington Ship Canal.

Wyatt Swift Hawkins (M. '27) division engineer for the Missouri State Highway Department, at Hannibal, Mo., died on July 15, 1937. Mr. Hawkins was born at Hannibal on December 18, 1876. His early career included experience as transitman and field assistant for the U. S. Geological Survey; transitman in the Office of Indian Affairs; state highway engineer of Oklahoma; and state highway engineer of Missouri. At various times Mr. Hawkins maintained consulting engineering practices in several cities—San Antonio, Tex.; Oklahoma City, Okla.; and Gulfport, Miss. (in the latter city from 1923 to 1930). During the war he served in the Corps of of Engineers, U. S. Army, with the rank of captain.

Alexander Edward Kastl (M. '90) civil engineer of Pelham Manor, N.Y., died on September 8, 1937. Mr. Kastl was born in Detroit, Mich., on September 15, 1861, and was graduated from the University of Michigan in 1895. From 1892 to 1896 he was division engineer for the Sanitary District of Chicago; from 1896 to 1902, division engineer on the Wachusett (Mass.) aqueduct and reservoir; from 1902 to 1904, chief engineer for the Denver Union Water Company; from 1907 to 1910 he was, successively, section engineer and division engineer for the New York City Board of Water Supply; and from 1911 to 1914, special deputy state engineer in charge of the Barge Canal for the state of New York. From the latter year until his death Mr. Kastl maintained a private consulting practice, and he was also with the New York City Board of Water Supply from 1922 to 1934.

Hunter McDonald (M. '88) Past-President of the Society, died on August 24, 1937, at the age of 77. Mr. McDonald was born in Winchester, Va., and educated at Washington and Lee University. He was connected with the Nashville, Chattanooga and St. Louis Railway for over fifty years, entering the employ of this organization in 1879. For many years—from 1892 until his retirement in 1931—he was chief engineer. Mr. McDonald was Director of the Society from 1903 to 1905; Vice-President from 1910 to 1911; and President in 1914. A more detailed account of his life appears elsewhere in this issue.

FRANK ALEXANDER MCINNES (M. '08) for many years connected with the Boston (Mass.) Department of Public Works, died in that city on August 9, 1937. Mr. McInnes, who was 80, was born in Fredericton, N.B., and educated at the University of New Brunswick. In 1887, after ten years in railroad engineering in this country and Canada, he entered the engineering department of the city of Boston. Among the positions that he held in his long service for the city were those of assistant engineer in charge of water department work and on the construction of a number of sewerage projects; assistant city engineer; and division engineer in the public works department.

JAMES DANIEL MICKEY (Jun. '36) a draftsman for the Central Nebraska Public Power and Irrigation District at Lincoln, Nebr., died on July 6, 1937, at the age of 24. Mr. Mickey was born in Lincoln and was graduated from the University of Nebraska in 1935. During summer vacations prior to his graduation, he was employed as a rodman, draftsman, and computer by the Burlington Railroad. In November 1935 Mr. Mickey became connected with the Central Nebraska Public Power and Irrigation District—for a time as office engineer on the construction of Keystone Dam.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

ELMER WILLARD PACKER (Assoc. M. '31) resident highway engineer for the New Jersey State Highway Department at Collingswood, N.J., died at Ocean City, N.J., on August 11, 1937. He was 42. Mr. Packer was born at Rosebank, N.Y., and educated at Rutgers University. From 1917 to 1922 he was with the Union County (N.J.) Engineering Department. In the latter year he became an assistant engineer in the New Jersey State Highway Department. Later he was made senior civil engineer, and from 1929 on he was resident highway engineer in charge of all highway construction work in the southern part of the state.

PHILIP SCOTT TYRE (Assoc. M. '12) architect and engineer of Philadelphia, Pa., died in that city on August 25, 1937, at the age of 56. Mr. Tyre was born in Wilmington Del., and educated at the Students School of Art, Denver, Colo., and the Pennsylvania Academy of Fine Arts. His early career included experience with the New York Shipbuilding Company and the Belmont Iron Works. From 1908 to 1914 he was chief engineer for George F. Pawling and Company, of Philadelphia, and from 1914 to 1918 he had a private architectural and engineering practice in Philadelphia. During the war Mr. Tyre was progress engineer for the Southern Pacific District of the Emergency Fleet Corporation. In 1920 he resumed his private practice.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From August 10 to September 9, 1937, Inclusive

ADDITIONS TO MEMBERSHIP

ARNOLD, HUGH MONTGOMERY (Jun. '37), Student Engr., U. S. Engrs., Box 592, Conchas Dam, N. Mex.

BANKSON, WOODFORD (Assoc. M. '37), Estimator, North Eastern Const. Co., 101 Park Ave., New York (Res., 2 Errol Pl., New Rochelle), N.Y.

BLAUVELT, JOHN IRVING (Assoc. M. '37), Chf. Engr., Warren and Arthur Smadbeck, Inc., New York, N.Y. (Res., 50 Walnut St., Little Falls, N.J.)

BOYER, PETER BOYAJIAN (Jun. '37), With Bureau of Public Roads, Kettle Falls, Wash. (Res., Y. M. C. A., Portland, Ore.)

BRITZIUS, CHARLES WESLEY (Jun. '37), Asst. in Highway Eng., Univ. of Minnesota (Res., 324 Walnut St., S.E.), Minneapolis, Minn.

CAPEN, CHARLES HERBERT (M. '37), Engr., North Jersey Dist. Water Supply Comm., 8 Florence Pl., West Orange, N.J.

CARROLL, ROBERT JAMES (Jun. '37), Draftsman, The Jeffrey Mfg. Co. (Res., 145 Blenheim Rd.), Columbus, Ohio.

COCHRANE, JOSEPH DERR (Jun. '37), With P.R.R., Kane (Res., 355 South St. Marys St., St. Marys), Pa.

DEL BOURGO, JACOB JOSEPH (Assoc. M. '37), Concrete Designer, Phoenix Eng. Corporation, 2 Rector St. (Res., 120 Haven Ave.), New York, N.Y.

DI GENOVA, EGIDIO OTTAVIO (Assoc. M. '37), With World's Fair Constr. Dept., Empire State Bldg., New York (Res., 319 Ralph Ave., Brooklyn), N.Y.

DURHAM, MAX JUDGE (Jun. '37), Care, U. S. Bureau of Reclamation, Parker Dam, Calif.

ENGSTRUM, THOMAS GEROLD (Assoc. M. '37), Building Insp., Public Utilities Dept., San Francisco Bay Exposition (Res., 2245 Larkin St.), San Francisco, Calif.

FENTON, CLYDE HENRY (Assoc. M. '37), Office Engr., Brazos River Conservation and Reclamation Dist., Kyle Hotel, Temple, Tex.

FLUHR, THOMAS WARREN (Assoc. M. '37), Asst. Geologist, Board of Water Supply, New York (Res., 27-27 Crescent St., Long Island City), N.Y.

GODAT, DAVID WALKER (M. '37), Maintenance Engr., Div., of Public Works, City of New Orleans (Res., 7826 Zimple St.), New Orleans, La.

HANNUM, ERWIN CHARLES (Jun. '37), 510 West 110th St., Apt. 12A, New York, N.Y.

HARRIS, MILTON (Assoc. M. '37), Associate Highway Engr., State Div. of Highways, Box 16, Bishop, Calif.

HARVEY, ELBERT HUEY (Assoc. M. '37), County Road Engr., Mason County, Maysville, Ky.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1937	
Members	5,610
Associate Members	6,008
Corporate Members	11,618
Honorary Members	23
Juniors	3,405
Affiliates	79
Fellows	1
Total	15,126

HAY, JOHN LEONARD (Jun. '37), In Chg., Eng. Dept., New Mexico Power Co., Santa Fé, N. Mex.

HELVENSTON, HUMBOLDT REY (Assoc. M. '37), Constr. Engr., Parkman Constr. Co., 1033 East Ohio St. N.S. (Res. 245 Ashland Ave., Mount Lebanon), Pittsburgh, Pa.

HEMBORG, RICHARD EDWIN (Assoc. M. '37), Care, Dept. of Water and Power, City of Los Angeles, 207 South Broadway, Los Angeles, Calif.

HOLMES, GLENN WILLIAM (Jun. '37), Asst. Hydr. Engr., Section of Watershed and Hydrologic Studies, SCS, Washington, D.C.

HOTCHKISS, WILLIAM OTIS (M. '37), Pres., Rensselaer Polytechnic Inst., Troy, N.Y.

JOHNSON, JOHN WILLIAM (Assoc. M. '37), Junior Engr., Buffalo Sewer Authority (Res., 65 Tillinghast Pl.), Buffalo, N.Y.

JUSTICE, FREDERICK EMERSON (Assoc. M. '37), 2285 Sedgwick Ave., Apartment 406, New York, N.Y.

KAHL, WILLIAM ROB (Jun. '37), Rodman, B. & O. R. R., Stapleton (Res., 79 Acacia Ave., Great Kills), N.Y.

KARP, ALFRED (Jun. '37), Under Eng. Aide, U. S. Engr. Office, Columbus, Miss.

KEEFER, THOMAS SMYTH, JR. (Jun. '37), With E. H. Keefer & Son (Res., 135 South 19th St.), Philadelphia, Pa.

KETTERING, CHARLES FRANKLIN (M. '37), Vice-Pres. and Director, Gen. Motors Corporation; Pres. and Director, Gen. Motors Research Corporation, Detroit, Mich. (Res., Ridgeleigh Terrace, Dayton, Ohio.)

KIMBALL, FRANK (Assoc. M. '37), Associate Agri.

Engr., SCS (Res., 30 East Fontanero), Colorado Springs, Colo.

KING, CHARLES GRANT (Jun. '37), Eng. Aide, TVA, Project Planning Div. (Res., 321 Fisher Pl.), Knoxville, Tenn.

KJELLMAN, VICTOR HARRY (Jun. '37), Student Engr., U. S. Engr. Office, Park Sq. Bldg., Boston, Mass.

KREMGOLD, DOV BER (Assoc. M. '37), Asst. Agri. Engr. and Associate Soil Conservationist, SCS, Washington, D.C.

KROLL, JOSEPH (Jun. '37), Field Engr., Columbia Constr. Co., Bonneville, Ore.

LANE, EDWARD NEIL WILTAMUTH (Jun. '37), Bridge Insp. and Instrumentman, State Dept. of Roads and Irrig., 1909 Perkins Boulevard, Lincoln, Nebr.

LOVELAND, CHESTER H. (M. '37), Pres., The Loveland Engrs., Inc., 485 California St., San Francisco, Calif.

LOWE, JOHN, III (Jun. '37), Care, Univ. of Maryland, College Park, Md.

LUMPKIN, LLOYD EARL (Assoc. M. '37), Southern Service Mgr., Marquette Cement Mfg. Co., 5110 Woodlawn, Little Rock, Ark.

LYON, GEORGE ALBERT (Assoc. M. '37), Eng. Insp., Inspection Div., PWA; U. S. A. C., Logan, Utah.

MEHTA, RAMESH SUMANT (Jun. '37), Drainage Engr., P. W. D., Takhteshwar, Bhavnagar, India.

MITCHELL, ANSEL NICHOLS (Assoc. M. '37), Supt. of Constr., J. C. Nichols Investment Co., 310 Ward Parkway, Kansas City, Mo.

MOORE, ARTHUR JOSEPH (Assoc. M. '37), Office Engr., International Boundary Comm., 701 North Dick Dowling St., San Benito, Tex.

NAGTEGAAL, GERRIT PAUL (Jun. '37), Eng. Contr. (Paul Nagtegaal & Son), 403 Western Ave., Sheboygan Falls, Wis.

NOWELL, JOSEPH CORNELL, JR. (Assoc. M. '37), Associate Engr., TVA (Res., 2938 Fountain Park Boulevard), Knoxville, Tenn.

ORBOK, GEORGE ALEXANDER, JR. (Assoc. M. '37), Mech. Engr., Station Eng. Dept., The Edison Elec. Illuminating Co. of Boston, Boston (Res., 5 Cleveland St., Cambridge), Mass.

PATTERSON, THOMAS SHAFFER (Assoc. M. '37), Associate Prof., in Chg. of Testing Materials, Pennsylvania State Coll. (Res., 609 West Fairmount Ave.), State College, Pa.

PITTS, STANFORD MCGRAW (Assoc. M. '37), Area Engr., Brazos River Conservation and Reclamation Dist., Kyle Hotel, Temple, Tex.

RAY, OLIVER ADAM (Jun. '37), Engr., W. W. Horner (Res., 3230 Michigan Ave.), St. Louis, Mo.

RITCHIE, RAYMOND DARROW (Assoc. M. '37), Contr., 103 Park Ave., New York, N.Y.

SCHNEIDER, ALFRED WILLIAM (Assoc. M. '37), Mgr., Gen. Supt., and Superv. Engr., B. A. Froemming Co., Milwaukee (Res., 2363 North 81st St., Wauwatosa), Wis.

SCHNEIDER, GEORGE RUSSELL (Assoc. M. '37), Associate Engr., U. S. Engr. Dept., 711 Ash St., Little Rock, Ark.

SHEPHERD, GEORGE EDWARD (Assoc. M. '37), Prin. Engr. Aide, U. S. Engr. Office, Gay Bldg., Little Rock, Ark.

STIRNE, ROBERT MARION (Jun. '37), Student Engr., U. S. Engr. Dept., Box 2544, Fort Peck, Mont.

STRANGE, ORMAN MORTON (Assoc. M. '37), Field Engr., Moffat Water Tunnel Project, Denver Board of Water Commrs. (Res., 3501 Osceola St.), Denver, Colo.

TODD, LAZARUS HOUSTON (Jun. '37), Eng. Aide, U. S. Engr. Corps, 2d New Orleans Dist., 2d Area (Res., 3d St. Walk, Apartment 2), Baton Rouge, La.

TORRE, MARIO DE LA (Jun. '37), Constr. and Field Engr., Cia. Colombiana de Electricidad, Apartado 171, Cali, Colombia.

TREWHITT, WAYNE DOUGLAS, JR. (Jun. '37), Care, Roberts Island Dredging & Impvt. Co., 508 Fifth St., Antioch, Calif.

VANDEVANTER, ELLIOTT (M. '37), Maj., Corps of Engrs., U.S.A., Care, 11th Engrs., Corozal, Canal Zone.

VOM SAAL, WALTER RUDOLF (Jun. '37), Junior Civ. Engr., RA, Constr. Div. (Res., 1750 P St., N.W.), Washington, D.C.

WISE, WILLIAM SPATZ (M. '37), Associate Engr., State Water Comm., Hartford (Res., 75 Lancaster Rd., West Hartford), Conn.

MEMBERSHIP TRANSFERS

ANDREW, ROBERT MORRISON (Jun. '33; Assoc. M. '37), Project Engr., State Highway Comm., Muncie, Ind.

BAUMAN, EDWARD WALTER (Assoc. M. '30; M. '37), Engr., Materials and Tests, State Highway Dept. (Res., 2819 Belcourt), Nashville, Tenn.

BINGLEY, WILLIAM MCLEAN (Jun. '29; Assoc. M. '37), Sales Engr., The Dorr Co., Inc. (Res., 1747 Flagler Ave., N.E.), Atlanta, Ga.

BROWNING, CLAUD FRANKLIN (Jun. '27; Assoc. M. '37), Public Health Engr., Consultant, Health Dept., District of Columbia (Res., 248 Hamilton St., N.W.), Washington, D.C.

CRAIG, FRANKLIN CURTISS (Jun. '30; Assoc. M. '37), Asst. Hydr. Engr., U. S. Geological Survey, 429 Federal Bldg., Boise, Idaho.

FELDMAN, MAX BERNARD (Jun. '27; Assoc. M. '37), Chf. Estimator, H. H. Robertson Co., 2000 Grant Bldg. (Res., 3741 Beechwood Boulevard, Squirrel Hill), Pittsburgh, Pa.

FISHER, LINDEN VAN HORN (Jun. '21; Assoc. M. '26; M. '37), Designer and Estimator, Bethlehem Steel Co., Fabricated Steel Constr. (Res., 230 Eleventh Ave.), Bethlehem, Pa.

FOLSOM, JAMES FORREST (Jun. '31; Assoc. M. '37), Junior Civ. Engr., Met. Dist. Water Supply Comm., Main Dam, Ware, Mass.

FORBES, HYDE (Jun. '16; Assoc. M. '20; M. '37), Engr., and Geologist, Humboldt Bank Bldg., San Francisco, Calif.

HALLETT, JAMES TILFORD (Assoc. M. '21; M. '37), Traffic Engr., State Highway Comm. (Res., 102 South Gladstone Ave.), Indianapolis, Ind.

HESTER, ELMER WEBB (Jun. '31; Assoc. M. '37), Res. Engr., State Highway Dept., 4202 Ave. D, Austin, Tex.

HEYSER, ALTON SCHULZE (Jun. '26; Assoc. M. '37), Res. Engr. Insp., PWA, 2 Lafayette St., New York, N.Y. (Res., 15 Alexander Ave., Madison, N.J.)

INGRAM, WILLIAM TRUITT (Jun. '30; Assoc. M. '37), San. Engr., San Joaquin County Local Health Dist., Box 111 (Res., 1111 College Ave.), Stockton, Calif.

JOHNSON, JOHN ALBERT (Jun. '32; Assoc. M. '37), R.F.D. 4, North Little Rock, Ark.

JOHNSON, OLIVER ARTHUR (Jun. '27; Assoc. M. '37), Dist. Engr., U. S. Engr. Office (Res., 1111 Polk St.), Vicksburg, Miss.

JOHNSON, WESTON MACLEOD (Jun. '29; Assoc. M. '37), Asst. Engr., Healy-Tibbitts Constr. Co., 64 Pine St. (Res., 2540 Judah St.), San Francisco, Calif.

KAISER, EDGAR FOSBURGH (Jun. '34; Assoc. M. '37), Mgr. of Operations, Columbia Constr. Co., Bonneville, Ore.

KINNISON, HARVEY BANKS (Assoc. M. '25; M. '37), Dist. Engr., U. S. Geological Survey, Water Resources Branch, 945 Post Office Bldg., Boston, Mass.

KUCHAR, JOSEPH JAROMIR (Jun. '19; Assoc. M. '26; M. '37), Secy., Treas., and Mgr., Kuchar Brothers, Montvale, N.J.

LEAHY, JOHN (Assoc. M. '24; M. '37), Supervisor, Linde Air Products Co., Prest-O-Lite Co., Carbide and Carbon Chemicals Corporation, 205 East 42d St., New York (Res., 30 Central Parkway, Mount Vernon), N.Y.

LI, WEN-PANG (Jun. '28; Assoc. M. '37), Chf., Designing Dept., Kwang Tung River Conservancy Bureau, White Cloud Rd., Canton, China.

MANGAN, JOHN WILLIAM (Assoc. M. '30; M. '37), Dist. Engr., U. S. Geological Survey, Harrisburg (Res., 200 South 24th St., Camp Hill), Pa.

MARKLE, HARRY ATKINS, JR. (Jun. '30; Assoc. M. '37), Estimator, Lehigh Structural Steel Co. (Res., 1 South Whitehall Ave., Greenawalds), Allentown, Pa.

MILLER, HERBERT WILFRED (Jun. '34; Assoc. M. '37), Asst. Highway Engr., Dist. IV, Div. of Highways (Res., 520 Geary St.), San Francisco, Calif.

NELSON, FREDERICK GRANT (Assoc. M. '29; M. '37), Sales Engr., The Dorr Co., Inc., 1231 Edison Bldg., Toledo, Ohio.

NOBLE, CHARLES MACINTOSH (Assoc. M. '27; M. '37), Asst. Engr., The Port of New York Authority, 111 Eighth Ave., Room 1532, New York, N.Y.

OLIVER, JOHN CRAIG (Jun. '29; Assoc. M. '37), Asst. Engr., City Engr's. Office, City Hall, Vancouver, B.C., Canada.

PEDIGO, JAMES ALAN (Jun. '32; Assoc. M. '37), County Surv., Los Angeles County Storm Drain Div., Los Angeles (Res., 4101 Liberty Boulevard, South Gate), Calif.

POTTS, CLIFFORD BERNARD (Jun. '33; Assoc. M. '37), With State Highway Dept., 2142 West Van Buren St., Phoenix, Ariz.

ROBISON, FRANK WILBUR (Jun. '33; Assoc. M. '37), Lassen Hotel, Red Bluff, Calif.

SCHEIDT, MELVIN EDGAR (Assoc. M. '27; M. '37), Asst. to State Director, PWA, 1106 Court Square Bldg., Baltimore, Md.

SEAL, BENJAMIN CALLISON (Jun. '31; Assoc. M. '37), Senior Civ. Draftsman, Sewage Disposal Project, City of Detroit (Res., 15475 Monica), Detroit, Mich.

STANLEY, CLAUDE MAXWELL (Jun. '26; Assoc. M. '37), Cons. Engr. (Young & Stanley, Inc.), 211 Iowa Ave., Muscatine, Iowa.

TIÓ Y NAZARIO DE FIGUEROA, AURELIO (Jun. '29; Assoc. M. '37), Contr., Puerto Rico Reconstruction Administration; Apartado 266, San Germán, Puerto Rico.

VAN HAGAN, LESLIE FLANDERS (Assoc. M. '11; M. '37), Prof., Railway Eng., Univ. of Wisconsin (Res., 2105 Madison St.), Madison, Wis.

VANONI, VITO AUGUST (Jun. '27; Assoc. M. '37), Project Mgr., Cooperative Research Laboratory, SCS and California Inst. of Technology (Res., 1201 East California St.), Pasadena, Calif.

WESTERHOFF, RUSSELL POST (Jun. '27; Assoc. M. '37), 823 East 23d St., Paterson, N.J.

WHANNEL, RAYMOND LEONALD (Jun. '26; Assoc. M. '29; M. '37), Asst. Highway Engr., State Div. of Highways, Bureau of Bridges (Res., 1544 West Cook St.), Springfield, Ill.

REINSTATEMENTS

COHEN, SIGMUND, Assoc. M., reinstated Aug. 18, 1937.

ISRAEL, CHARLES STANLEY, Assoc. M., reinstated Aug. 25, 1937.

JERAULD, HENRY FRANKLIN, Assoc. M., reinstated Sept. 7, 1937.

JUDSON, FREDERICK, Jun., reinstated Aug. 16, 1937.

MOTTIER, CHARLES HELVETIUS, M., reinstated Aug. 16, 1937.

POHMER, ALBERT EDWARD, Assoc. M., reinstated Aug. 26, 1937.

SYKES, GLENTON GODFREY, Assoc. M., reinstated Sept. 7, 1937.

WEISS, ALEXANDER, Jun., reinstated Aug. 16, 1937.

RESIGNATIONS

HAINES, DONALD HUTCHINSON, Jun., resigned Aug. 16, 1937.

LUDEMAN, RICHARD HOUSTON, Jun., resigned Aug. 24, 1937.

ROOF, WENDELL PRESCOTT, M., resigned Aug. 26, 1937.

SIMPSON, CARL WILLIAM, M., resigned Sept. 3, 1937.

TAKAHASHI, SHISUKE, Assoc. M., resigned Sept. 3, 1937.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

October 1, 1937 NUMBER 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

ABDUN-NUR, EDWARD AMIN, Denver, Colo. (Age 34.) Soils Technician, Board of Water Commrs. Refers to H. S. Crocker, C. H. Paul, E. H. Schneider, C. H. Scholer, R. J. Tipton.

AEPPLI, ERNEST, Sacramento, Calif. (Age 41.) Structural Designer, Bridge Dept., State of California. Refers to J. Gallagher, C. H. Kromer, L. H. Nishkian, F. W. Panhorst, F. H. Spitzer, H. D. Stover.

ANDREASSEN, ALEXANDER TORLEIV, Brooklyn, N.Y. (Age 21.) Refers to H. P. Hammond, E. J. Squire.

ARONSON, CECIL, Rochester, N.Y. (Age 39.) Asst. Engr., Eastman Kodak Co. Refers to C. H. Brown, F. F. Gordon, R. C. Schwind, G. P. A. Stape, C. F. Starr.

ARROYO, RAOUL NICHOLAS, Philadelphia, Pa. (Age 24.) Refers to H. L. Bowman, S. J. Leonard.

BEALL, JOEL CHAMBLESS, Pickwick Dam, Tenn. (Age 23.) Refers to R. P. Black, F. C. Snow.

BENITO, ROBERT VALENTINE, Hollis, N.Y. (Age 21.) Refers to H. P. Hammond, L. F. Rader, E. J. Squire.

BENNETT, HARRIS SHELL, Los Angeles, Calif. (Age 34.) Associate Structural Engr., U. S. Engr. Dept. Refers to E. J. Bednarski, V. W. Bullock, L. T. Evans, F. H. Horton, L. R. Young.

BILUND, ALEX, San Bruno, Calif. (Age 30.) Structural Steel Detailer, Bethlehem Steel Co., Tower Dept. Refers to W. L. Malony, B. L. Peterson, M. K. Snyder.

BLALOCK, JAMES ARTHUR, South Richmond, Va. (Age 22.) Eng. Apprentice, Pennsylvania R.R. Refers to R. B. H. Begg, F. J. Sette.

BODINE, ROBERT YEOMANS, Bethlehem, Pa. (Age 23.) Refers to S. A. Becker, M. O. Fuller, C. D. Jensen, H. G. Payrow, H. Sutherland.

BOHMANN, GEORGE, Chicago, Ill. (Age 24.) Inspection Engr., Pittsburgh Testing Laboratory. Refers to J. G. Bennett, D. C. Jackson, Jr.

BRADY, WILLIAM CAMPBELL, Ft. Sumner, N. Mex. (Age 28.) Jun. Civ. Engr., with Resettlement Administration. Refers to H. B. Elmendorf, F. G. Healy, G. L. Seligmann, V. J. Von Schoeler, W. A. Von Schoeler.

BRAGG, RALPH STANLEY, Horse Cave, Ky. (Age 48.) Land Buyer, U. S. Dept. Interior, National Park Service. Refers to A. P. Bursley, L. M. Gray, R. F. MacDowell, L. B. Olson, O. G. Taylor.

BRIDGER, JOHN CASH, State College, Miss. (Age 31.) Asst. Prof. of Civ. Eng., Mississippi State College. Refers to D. W. Crofoot, J. R. Ellis, D. M. McCain, A. E. Nance, G. A. Ridgeway, F. W. Sayers, W. R. Spencer, S. Thompson.

BROUGH, LIONEL FREDERICK, Binghamton, N.Y. (Age 24.) Inspector, U. S. Engrs., War. Dept., Binghamton (N.Y.) Dist. Refers to W. Allan, R. E. Goodwin.

BUCKMAN, HENRY HOLLAND, Washington, D.C. (Age 50.) Eng. Counsel, National Gulf-Atlantic Ship Canal Association. Refers to R. M. Angas, M. Pirnie, G. W. Simons, Jr., L. E. Thornton, G. A. Youngberg.

BUXTON, ALFRED CULVER, Santa Monica, Calif. (Age 26.) Structural Draftsman, W. P. Neil Co., Ltd., Los Angeles, Calif. Refers to R. M. Fox, R. R. Martel, F. Thomas, D. M. Wilson.

CALKINS, JOHN NORMAN, Mason City, Wash. (Age 21.) Draftsman, Mason-Walsh-Atkinson-Kier Co. Refers to C. L. Allen, C. M. Cade.

CARLSON, LEONARD ARTHUR, Moline, Ill. (Age 27.) Asst. Engr., Corps. of Engrs., U. S. Army, Rock Island, Ill. Refers to J. H. Childs, F. L. Flynt, J. B. Jewett, R. G. Kasel, E. W. Lane, H. P. Warren.

CLARK, EDWARD SHANNON, East Worcester, N.Y. (Age 34.) In private practice. Refers to E. R. Cary, L. W. Clark, G. E. Rickard, W. C. Ruland, H. O. Sharp.

CLAUSSEN, ELMER LEROY, Ft. Logan, Colo. (Age 24.) 2d Lieut., Co. A, 2d Engrs., U. S. Army. Refers to D. H. Harkness, C. B. Mickey.

COLLINS, DON WARLICK, Junction City, Kans. (Age 25.) Refers to L. E. Conrad, F. F. Frazier, M. W. Furr, R. F. Morse, C. A. Walkwitz, L. V. White.

CRAWFORD, IVAN CHARLES, JR., Lawrence, Kans. (Age 22.) Refers to J. B. Buchanan, I. N. Carter, H. B. Phelps.

CRICENTI, NICHOLAS JOSEPH, Concord, N.H. (Age 22.) Refers to E. W. Bowler, R. S. Skelton.

Cron, Frederick William, Hot Springs, Ark. (Age 31.) Asst. Engr., acting as Office Engr. and Asst. to Res. Engr., U. S. Bureau of Public Roads. Refers to E. W. James, C. T. Johnston, W. I. Lee, J. V. McNary, H. J. Spelman.

Dodge, Clifford Francis, Jr., Leicester, Mass. (Age 22.) Timekeeper, Fiske Carter Construction Co., Worcester, Mass. Refers to H. P. Burden, F. N. Weaver.

Downs, John Austin, New Brighton, N.Y. (Age 22.) Refers to E. W. Bowler, R. R. Skelton.

duRell, Charles Terry, Redondo Beach, Calif. (Age 65.) Refers to W. H. Dunlap, L. C. Hill, I. Livingston, L. R. Lohr, W. D. Waltman.

Ernest, Ralph Nelson, Drexel Hill, Pa. (Age 29.) Refers to L. W. Clark, H. O. Sharp.

Firling, Christian Winslow, Ridgewood, N.J. (Age 22.) Refers to M. O. Fuller, C. D. Jensen, H. G. Payrow, H. Sutherland, D. T. Webster.

Firmin, Philip, Washington, D.C. (Age 21.) Engr., Ft. Lincoln Cemetery. Refers to H. R. Hall, S. S. Steinberg.

Forbes, Robert, Norris, Tenn. (Age 25.) Jun. Civ. Engr., TVA. Refers to J. B. Babcock, 3d, C. B. Breed, A. S. Fry, T. Human, Jr., M. J. Naughten, W. W. Studdert.

Fraser, R. Lee, McCrory, Ark. (Age 22.) Asst. to Engr., Bayou De View Drainage Dist. Refers to K. W. LeFever, W. R. Spencer.

Freeman, Waldo Drake, Tucson, Ariz. (Age 24.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

Fuertes, Joaquin Rodriguez, Santurce, Puerto Rico. (Age 27.) Refers to G. N. Cox, B. W. Pegues, F. F. Pillet.

Gedney, Robert Hugo, Cleveland, Ohio. (Age 22.) Refers to G. E. Barnes, M. S. Douglas.

Goldsmith, Robert Herman, New York City. (Age 22.) Refers to J. B. Babcock, 3d, J. D. Mitsch.

Gookin, William Scudder, Tucson, Ariz. (Age 23.) Refers to R. O'Donnell, E. D. Walker.

Grasso, Salvatore, Durham, N.H. (Age 23.) Graduate Asst. in Civ. Eng., Univ. of New Hampshire. Refers to E. W. Bowler, R. R. Skelton.

Grbulich, Bernard James, Reno, Nev. (Age 25.) Jun. Bridge Designer and Draftsman, Bridge Dept., Nevada State Highway Dept. Refers to H. P. Boardman, R. B. Ketchum.

Grossmann, Paul Royal, Glenmont, N.Y. (Age 21.) Timekeeper for Contract 8978, Chicago Bridge & Iron Co., Albany, N.Y. Refers to L. W. Clark, E. R. Wiseman.

Guerin, Thomas Gerard, Brooklyn, N.Y. (Age 32.) Engr., Tully & DiNapoli, Inc., Long Island City, N.Y. Refers to R. C. Brumfield, M. B. Case, F. E. Foss, H. B. Gates, H. W. Hudson, R. W. McMullen, A. A. Mittag, R. T. Robinson, A. J. Vernon, R. F. Wheadon, J. P. J. Williams.

Hagy, Richard Claude, Philadelphia, Pa. (Age 23.) Refers to H. L. Bowman, S. J. Leonard.

Hansen, Norman Groves, Palo Alto, Calif. (Age 26.) Refers to S. B. Morris, L. B. Reynolds, J. B. Wells.

Hechmer, Carl Adam, Hyattsville, Md. (Age 42.) Dept. Engr., in charge of Maintenance and Operation Dept., Washington Suburban San. Dist. Refers to J. W. Armstrong, W. W. Brush, L. H. Enslow, G. L. Hall, H. R. Hall, G. J. Requardt, E. B. Whitman, A. Wolman.

Heft, George Albert, New Orleans, La. (Age 21.) Constr. and Maintenance Clerk, Shell Petroleum Co. Refers to D. Derickson, F. P. Hamilton.

Hoffmann, Lewis Edward, Guntersville, Ala. (Age 22.) Refers to H. L. Bowman, S. J. Leonard.

Hopkins, Leonard Otis, Jr., Knoxville, Tenn. (Age 26.) With Constr. Plant Div., TVA. Refers to J. G. Allen, R. T. Colburn, F. J. Lewis, E. Weidemann.

Houston, Clyde Erwin, Tucson, Ariz. (Age 23.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

Jackson, Robert Austin, Washington, D.C. (Age 24.) Refers to S. S. Steinberg, G. A. Wick.

Jesatko, Anthony John, Baltimore, Md. (Age 20.) Refers to T. P. Comber, Jr., T. F. Hubbard, F. W. Medaugh, J. T. Thompson.

Kelley, Cott C., Fairfield, Ala. (Age 54.) Chf. Field Engr. and Asst. Supt. of Constr., Tennesee Coal, Iron & R.R. Co. Refers to R. L. Acker, W. J. Carrel, H. A. Davies, A. C. Decker, A. B. Dunning, C. R. Hopper, W. N. Woodbury.

Keppler, Louis Frank, Cincinnati, Ohio. (Age 24.) Refers to J. E. Deignan, H. B. Luther.

Keyes, Richard Jay, Indianapolis, Ind. (Age 22.) Refers to R. A. Hall, W. C. Taylor.

Klunk, John Benedict, Toledo, Ohio. (Age 67.) Vice-Pres., Gen. Mgr. and Chf. Engr., The Continental Bitumen Co. Refers to F. W. Cherrington, L. T. Ericson, A. S. Forster, C. B. Patterson, G. N. Schoonmaker.

Lake, Robert Warren, LaCrosse, Wis. (Age 25.) Rodman, Chicago, Milwaukee, St. Paul & Pacific R.R. Refers to H. E. Babbitt, G. H. Dell, J. J. Doland, W. C. Huntington, G. W. Pickels, T. C. Shedd.

Larson, Carl Earl, Jr., Worcester, Mass. (Age 22.) Refers to A. W. French, J. W. Howe, A. J. Knight.

Ledyard, Russel Brockway, Denver, Colo. (Age 24.) Jun. Draftsman, State Highway Dept. Refers to W. E. Brockway, R. L. Downing, C. L. Eckel, E. W. Raeder.

Lehto, Reino Hjalmer, Keweenaw Bay, Mich. (Age 22.) Refers to G. C. Dillman, W. C. Polkinghorne.

Leitner, Elton Raymond, Cambridge, Idaho. (Age 27.) Engr., Forest Service, Weiser National Forest. Refers to J. E. Buchanan, I. N. Carter, I. C. Crawford, J. W. Howard.

Lindstrom, William Anthony, Birmingham, Ala. (Age 22.) Student Engr., Tennessee Coal, Iron & R.R. Co. Refers to R. P. Black, C. D. Gibson, F. C. Snow.

Lipson, Samuel Lloyd, Huntington Park, Calif. (Age 24.) Refers to R. R. Martel, F. Thomas.

MacLean, Edward Archibald, Augusta, Maine. (Age 40.) Senior Engr., Main Highway Dept., Bridge Div. Refers to H. Cross, H. L. Doten, R. D. Field, J. J. Richey, W. B. Wendt, B. T. Weston.

McBroom, Earl Henry, Sacramento, Calif. (Age 39.) Associate Bridge Designing Engr., California Div. of Highways. Refers to C. B. Breed, G. T. Kuntz, R. J. Middleton, F. W. Panhorst, W. E. Stoddard, H. D. Stover, T. B. Waddell.

McDougal, John Smith, San Francisco, Calif. (Age 32.) Assoc. Engr., U. S. Engr. Dept. Refers to J. S. Allen, C. E. Boesch, F. C. Carey, N. W. Haner, T. T. Knappen, T. B. Larkin, J. C. H. Lee, B. B. Somervell.

Mahoney, Robert Matthew, Bishop, Calif. (Age 22.) Checker of Materials, U. S. Vanadium Corporation. Refers to R. R. Martel, W. W. Michael, F. Thomas.

Malby, William Teahen, Jr., New York City. (Age 24.) Draftsman with Waddell & Hardesty. Refers to H. O. Sharp, E. R. Wiseman.

Masciocchi, Pius James, Hershey, Pa. (Age 23.) Refers to H. L. Bowman, S. J. Leonard.

Meszaros, Leslie Joseph Michael, New Haven, Conn. (Age 26.) Refers to H. B. Alvord, C. T. Bishop, R. H. Suttie.

Mickelsen, Henry Ernst, Chicago, Ill. (Age 21.) Refers to F. Bass, A. S. Cutler.

Millard, Robert West, Ely, Nev. (Age 25.) Res. Engr., WPA, Dist. No. 4. Refers to F. L. Bixby, H. P. Boardman.

Minder, Charles Andrew, Philadelphia, Pa. (Age 24.) Refers to H. L. Bowman, S. J. Leonard.

Moncure, Leah (Miss), Bastrop, Tex. (Age 30.) Asst. Office Engr., Texas State Highway Dept. Refers to J. A. Focht, C. R. Haile, T. E. Huffman, W. W. McClendon, W. E. Robinson, A. J. Wise.

Mullen, James McLean, Sausalito, Calif. (Age 23.) Refers to S. B. Morris, C. Moser, L. B. Reynolds, E. C. Thomas, A. L. Trowbridge, J. B. Wells.

Olsson, Calvin Carl, Brookings, S. Dak. (Age 35.) Asst. Prof. in Civ. Eng., South Dakota State Coll. Refers to R. Adams, H. B. Blodgett, H. S. Carter, A. H. Fuller, H. T. Person, G. A. Ridgeway.

Osterberg, Johj Oscar, New York City. (Age 22.) Refers to D. M. Burmister, A. Casagrande, J. K. Finch, J. F. Sanborn.

Palmer, Benjamin Harvey, Rochester, N.Y. (Age 45.) New York State Mgr. for Universal Concrete Pipe Co. Refers to W. S. Downs, C. P. Fortney, T. S. Lang, H. McGraw, S. S. Neff, M. W. Smith, Jr.

Pease, Chester Chapin, Jr., Concord, N.H. (Age 21.) Refers to E. W. Bowler, R. R. Skelton.

Plowe, Jason, Sacramento, Calif. (Age 28.) Asst. Bridge Engr., Bridge Dept., Div. of Highways, State of California. Refers to C. Derleth, Jr., J. G. Meyer, F. W. Panhorst.

Rader, Emerald Glenn, Wichita, Kans. (Age 27.) Senior Rodman, Constr. Dept., Kansas Highway Comm. Refers to L. E. Conrad, M. W. Furr, L. V. White.

Raine, Oliver Hamilton, Chattanooga, Tenn. (Age 22.) Asst. Eng. Draftsman, TVA. Refers to A. W. French, J. W. Howe, C. F. Meyer.

Rait, Donald Myron, Claymont, Del. (Age 23.) Apprentice, General Chemical Co. Refers to J. R. Lapham, M. Macartney.

Ramberg, Eivind Gunnar Frank, Brooklyn, N.Y. (Age 26.) Refers to H. R. Codwise, H. P. Hammond.

Reilly, William Chester, Brooklyn, N.Y. (Age 28.) Refers to H. W. King, C. O. Wisler.

Reiwitz, Al Ackland, San Francisco, Calif. (Age 24.) Structural Designer, H. T. Gettins Co. Refers to C. L. Eckel, M. P. Kitchel.

Rhoton, Donald Gale, Pickwick Dam, Tenn. (Age 24.) Refers to E. F. Coddington, J. M. Montz, C. T. Morris, J. R. Shank, R. C. Sloane.

Robertson, Dan Duane, Palo Alto, Calif. (Age 26.) Engr., Soule Steel Co., San Francisco, Calif. Refers to H. J. Brunnier, S. B. Morris, W. H. Popert, L. B. Reynolds, E. C. Thomas.

Robey, Harry Francis, Jr., Edgewood, Pa. (Age 22.) With Eng. Dept., Aluminum Co. of America. Refers to F. M. McCullough, C. B. Stanton, H. A. Thomas.

Robinson, Donald Stephen, Chicago, Ill. (Age 23.) Refers to W. C. Huntington, T. C. Shedd.

Roesch, Theophil, Indianapolis, Ind. (Age 39.) Draftsman and Designer, Bridge Dept., and Bldg. Div., State Highway Comm. of Indiana. Refers to D. Doggett, C. H. Hurd, M. R. Keefe, F. Kellam, J. W. Moore.

Schlenker, Norman Edward, Pottstown, Pa. (Age 21.) Refers to F. A. Barnes, J. E. Perry, P. H. Underwood.

Schofield, Albert Mervine, Philadelphia, Pa. (Age 23.) Refers to H. L. Bowman, S. J. Leonard.

SHANNON, GERARD THOMAS, Jersey City, N.J. (Age 21.) Refers to J. J. Costa, M. Garsaud, A. V. Sheridan, A. L. Sherman.

SHOLTES, CHARLES ALFRED, Schoharie, N.Y. (Age 21.) Refers to R. A. Hall, W. C. Taylor.

SIGHTS, ERNEST EARL, Fremont, Nebr. (Age 22.) Refers to C. M. Duff, C. E. Mickey.

SMITH, PAUL AMOS, Neville Island, Pa. (Age 41.) Vice-Pres. and Gen. Mgr., Hunter Steel Co. Refers to C. R. Andrew, R. P. Davis, H. R. Hortenstine, G. Jeppesen, E. K. Morse, G. S. Richardson, W. M. Smith.

STEPHENSON, FELIX LEE, Paris, Tex. (Age 31.) Asst. Res. Engr., Texas State Highway Dept. Refers to S. D. Bacon, L. D. Cabaniss, C. C. Cagle, F. M. Davis, H. H. Peel, J. E. Pirie.

STEVENS, GEORGE BICKLEY, Spring City, Pa. (Age 21.) Refers to H. L. Bowman, S. J. Leonard.

STONE, THERON BURNHAM, Yakima, Wash. (Age 25.) Foreman, State of Washington Dept. of Highways. Refers to H. E. Phelps, M. K. Snyder.

STRONG, SHELDON ARTHUR, Denver, Colo. (Age 26.) Jun. Draftsman, Colorado State Highway Dept. Refers to P. S. Bailey, R. L. Downing, C. L. Eckel, S. B. Lamb.

SWENSON, JOHN PERRY, St. Paul, Minn. (Age 21.) Refers to F. H. Bass, A. S. Cutler, A. J. Duvall, L. G. Straub.

SWIDZINSKI, EDMUND, Quincy, Mass. (Age 21.) Refers to E. W. Bowler, R. R. Skelton.

TAPLIN, ABRAHAM, New York City. (Age 21.) Asst. Eng. Aide, Navy Dept., Bureau of Constr. and Repair. Refers to R. E. Goodwin, L. C. Pope.

THOMPSON, GEORGE ROBERG, Detroit, Mich. (Age 52.) Cons. Engr. and Budget Director, State of Michigan. Refers to L. E. Ayres, J. H. Cissel, G. H. Fenkell, L. M. Gram, W. C. Hirn, W. R. Kales, F. G. Legg, Jr., L. G. Lenhardt, L. J. Nowicki, E. D. Rich, H. E. Riggs, L. C. Smith, H. F. Vaughan.

THORSON, ROBERT HENRY, Charleston, S.C. (Age 21.) Refers to J. B. Babcock, 3d, C. B. Breed, J. D. Mitsch, C. M. Spofford.

TILDEN, MARSHALL SENIOR, San Francisco, Calif. (Age 27.) Engr. Clerk (Acting Res. Engr. Inspector), Inspection Div., PWA. Refers to O. E. Carr, W. C. Hammatt, M. M. Lewis, W. S. Post, A. D. Wilder.

TROTTER, CLAUDE HOUSTON, Gorin, Mo. (Age 21.) Chainman and Rodman with Atchison, Topeka and Santa Fe Ry. Co. Refers to E. Boyce, G. W. Bradshaw, D. D. Haines, J. O. Jones, W. C. McNown.

TUSKIND, EUGENE RANDALL, Bismarck, N.Dak. (Age 35.) Office Engr., North Dakota State Highway Dept. Refers to A. Boyd, S. M. Brown, E. F. Chandler, H. E. Fowler, E. R. Griffin, G. E. Hanson, C. Johnson.

TUTHILL, LEWIS HAMILTON, Banning, Calif. (Age 37.) Concrete Engr., Metropolitan Water Dist. of Southern California. Refers to J. L. Burkholder, R. E. Davis, R. B. Diemer, J. H. Fertig, J. Hinds, J. Stearns, F. Thomas.

VAN WAGONER, MURRAY DELOS, Lansing, Mich. (Age 39.) State Highway Commissioner of Michigan. Refers to J. H. Cissel, M. E. Cooley, L. M. Gram, G. D. Kennedy, L. C. Kingscott, L. G. Lenhardt, H. E. Riggs.

VARLAN, PETER THOMAS, Rochester, N.Y. (Age 22.) Refers to F. A. Barnes, C. Crandall, J. E. Perry, R. Y. Thatcher, P. H. Underwood.

VOLK, HARRY JOSEPH, JR., Bethlehem, Pa. (Age 29.) Structural Draftsman, Bethlehem (Pa.) Steel Co. Refers to G. E. Beggs, L. D. Draper, L. R. Schureman, E. K. Timby, F. C. Waddell.

WEATHERBY, MARION EVERETTE, JR., Knoxville, Tenn. (Age 22.) Asst. Eng. Draftsman, Design and Constr. Dept., TVA. Refers to A. C. Barrow, J. A. C. Callan.

WEBER, CARL, Jacksonville, Fla. (Age 65.) Pres., Shore Line Builders, Inc.; also Pres., The Weber Co. Inc., and Vice-Pres., The Eppolith Products, Inc. Refers to R. M. Angas, B. C. Collier, W. W. Fineren, H. D. Mendenhall, P. L. Reed, G. W. Simons, Jr., G. A. Youngberg.

WEDGE, ARTHUR HENRY, Bedford, Ohio. (Age 33.) City Mgr. Refers to E. Kitchen, R. F. MacDowell, G. A. Reese, F. D. Stewart, F. H. Waring.

WHITE, GEORGE RICHARD, Buffalo, N.Y. (Age 43.) In private practice. Refers to G. F. Fisk, J. T. Mockler, A. P. Skaer, G. J. Summers, W. S. Thomson.

WILDMAN, ROBERT APRILL, Washington, D.C. (Age 23.) Inspector, Underwriters' Association of District of Columbia. Refers to R. W. Crum, J. R. Lapham.

WILLETT, ALBERT BERTRAM, Sacramento, Calif. (Age 41.) Asst. Designing Engr., State of California. Refers to C. E. Andrew, F. W. Panhorst, C. S. Pope, T. E. Stanton, Jr., H. E. Warrington.

WILLIAMS, LAWRENCE PERRY, Ambridge, Pa. (Age 24.) Refers to H. N. Benkert, F. J. Hanrahan, E. D. Walker.

WILLIAMS, ROBERT KNOLL, Los Angeles, Calif. (Age 23.) Refers to R. M. Fox, D. M. Wilson.

WITTE, HERBERT WALTER, Atlanta, Ga. (Age 24.) Draftsman, Georgia State Highway Dept. Refers to R. P. Black, C. D. Gibson, W. A. Hansell, F. C. Snow.

WRIGHT, JOHN ROBERT, Quincy, Ill. (Age 23.) Refers to J. S. Dodds, F. Kerekes.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

BENDT, JOSEPH PHILIP, Assoc. M., Detroit, Mich. (Elected Aug. 31, 1925.) (Age 49.) Constr. Engr., and Asst. Supt., Semet-Solvay Eng. Corporation, New York City. Refers to H. N. Cole, L. Hart, W. C. Hirn, A. B. Morrill, M. B. Owen, L. C. Wilcoxen.

GELLERT, NATHAN HENRY, Assoc. M., Meadowbrook, Pa. (Elected Oct. 9, 1917.) (Age 48.) Pres., Atlantic Gas. Co. (National Public Utilities Corporation), also Great Lakes Utilities Co. Refers to R. M. Cooksey, F. G. Deker, H. E. Ehlers, S. E. Fairchild, Jr., T. E. Seelye, J. W. Townsend, Jr.

GRANT, EUGENE LODEWICK, Assoc. M., Stanford University, Calif. (Elected April 12, 1926.) (Age 40.) Associate Prof. of Economics of Eng., Stanford Univ. Refers to J. C. L. Fish, N. C. Grover, C. S. Heidel, S. B. Morris, L. B. Reynolds, A. J. Schafmayer, F. E. Turneaure.

MENG, CARL LEROY, Assoc. M., Phoenix, Ariz. (Elected Nov. 26, 1934.) (Age 41.) Asst. Engr., Bureau of Reclamation, Mormon Flat Dam, Salt River Project, Ariz. Refers to H. K. Barrows, E. C. Koppen, C. Myers, W. B. Poland, F. A. Russell.

MINEAR, VIRGIL LUTHER, Assoc. M., Denver, Colo. (Elected Nov. 10, 1930.) (Age 45.) Asst. Engr. and Associate Engr., U. S. Bureau of Reclamation. Refers to F. A. Banks, M. E. Gilmore, B. A. Hall, J. B. Hays, P. A. Jones, E. C. Koppen, W. H. Nalder, J. C. Page, A. Ruettgers, J. L. Savage, W. R. Young.

POHMER, ALBERT EDWARD, Assoc. M., Bradshaw, Md. (Elected Feb. 10, 1930.) (Age 39.) In private practice, Baltimore, Md. Refers to W. T. Ballard, C. R. Burdette, H. R. Hall, A. H. Hartman, S. S. Steinberg, A. Wolman.

ROBERTS, ELLIOTT BURGESS, Assoc. M., Boston, Mass. (Elected Junior June 19, 1922; Assoc. M. June 6, 1927.) (Age 38.) With U. S. Coast & Geodetic Survey, in charge of field station. Refers to W. Bowie, L. O. Colbert, E. W. Eickelberg, G. T. Rude, P. C. Whitney.

SCHMIED, ERICH ERNEST, Assoc. M., Memphis, Tenn. (Elected Oct. 15, 1923.) (Age 44.) Member of firm, S & W Constr. Co. Refers to E. L. Harrison, L. L. Hidinger, H. N. Howe, B. S. Merrill, V. H. Smith.

SCHUTZ, MAX ADOLF, Assoc. M., Detroit, Mich. (Elected June 10, 1929.) (Age 47.) Structural Engr., Great Lakes Steel Corporation. Refers to E. F. Ball, H. R. Bickle, J. Jones, W. R. Kales, C. E. Lilliestrand.

TAYLOR, FREDERICK CHARLES, Assoc. M., Lansing, Mich. (Elected Junior Feb. 25, 1924; Assoc. M. Oct. 10, 1927.) (Age 41.) Director, Michigan Highway Planning Survey, Michigan State Highway Dept. Refers to J. H. Cissel, M. E. Cooley, J. L. Crane, Jr., L. M. Gram, W. C. Hirn, W. C. Hoad, R. L. McNamee, E. C. Shoecraft, A. L. Trout.

TSAI, FANG-YIN, Assoc. M., Peiping, China. (Elected Junior Oct. 10, 1927; Assoc. M. Jan. 17, 1933.) (Age 36.) Prof. of Structural Eng., National Tsing Hua Univ. Refers to D. Peabody, Jr., N. A. Richards, C. M. Spofford, H. V. Spurr, H. Sutherland, C. Terzaghi.

WEST, GORDON RUSSELL, Assoc. M., St. Louis, Mo. (Elected Nov. 10, 1930.) (Age 40.) Reclamation Engr., Missouri Pacific Lines. Refers to L. W. Baldwin, E. M. Durham, Jr., C. S. Kirkpatrick, J. A. Norris, H. R. Safford.

WILLIS, WILLIAM PREY, Assoc. M., Baytown, Tex. (Elected Sept. 10, 1923.) (Age 45.) Asst. Supt., in charge of Eng. & Mech. Dept., Humble Oil & Refinery Co. Refers to J. B. Dannenbaum, C. R. Haile, W. W. McClendon, S. W. Oberg, C. L. Tindall.

WILLS, RONALD BLAIR, Assoc. M., Topeka, Kans. (Elected April 23, 1928.) (Age 41.) Engr. of Design, State Highway Comm. of Kans. Refers to H. D. Barnes, W. V. Buck, L. E. Conrad, F. W. Epps, G. S. Knapp, C. H. Scholer.

FROM THE GRADE OF JUNIOR

ARLT, ARTHUR WILLIAMSON, Jun., Denver, Colo. (Elected Nov. 11, 1929.) (Age 32.) Asst. Engr., U. S. Dept. of the Interior, Bureau of Reclamation. Refers to H. C. Boardman, L. R. Douglass, W. E. Joyce, C. Rawhouser, B. W. Steele, R. D. Welsh.

BAILEY, LEONARD CASSELL, Jun., Knoxville, Tenn. (Elected Oct. 29, 1934.) (Age 31.) Engr., City Engr's. Office. Refers to J. G. Allen, C. N. Bass, A. J. Bottiger, H. H. Hale, W. F. Moehlman.

BANKS, HARVEY OREN, Jun., Watsonville, Calif. (Elected Nov. 10, 1930.) (Age 27.) Asst. Project Engr., U. S. Soil Conservation Service. Refers to H. R. Banks, E. F. Berry, R. S. Carberry, G. W. Gosline, C. T. Judah, L. Mitchell, H. E. Reddick, L. B. Reynolds, W. F. Trigeiro.

COPELAND, RAY EDWIN, Jun., Chicago, Ill. (Elected June 4, 1928.) (Age 32.) Sales Engr., Carnegie-Illinois Steel Corporation. Refers to N. M. Hench, R. P. Pennoyer, A. F. Reichmann, M. E. Salsbury, F. Thomas, H. vanZandt, W. G. Zimmermann.

DAVIDSON, ROSCOE ALEXANDER, Jun., Johnstown, Pa. (Elected Oct. 1, 1928.) (Age 32.) Constr. Engr. and Supt., Porterfield-Binger Constr. Co., Youngstown, Ohio. Refers to R. R. Barton, J. H. Cissel, A. E. Farrington, C. P. Fortney, T. C. Frame, L. M. Gram, R. N. Waid.

DOHERTY, CHARLES FRANCIS, Jun., New York City. (Elected Dec. 5, 1927.) (Age 32.) Prin. Engr., WPA, under Public Works Officer, New York. Refers to F. B. Forbes, S. L. Gatslick, M. E. Milone, M. J. Naughten, H. C. Paddock.

HARRISON, EDGAR SCRUGGS, Jun., Chattanooga, Tenn. (Elected Oct. 26, 1931.) (Age 32.) Eng. Dept., Tennessee Elec. Power Co. Refers to A. W. Crouch, J. C. Guild, Jr., F. Kurtz, O. J. Miller, N. F. Williams, W. H. Wilson.

HOLSTEIN, PAUL WHERRITT, JR., Jun., Columbus, Ohio. (Elected Feb. 27, 1933.) (Age 27.) Senior Asst. Engr., Div. of Eng. & Constr., City of Columbus. Refers to R. A. Allton, J. H. Blodgett, P. M. Holmes, R. B. Jennings, W. H. Knox, R. T. Regester, F. D. Stewart.

Johnson, Walter Kenneth, Jun., Norris, Tenn. (Elected Oct. 10, 1927.) (Age 32.) Senior Eng. Aide and Asst. Hydr. Engr., TVA. Refers to C. M. Allen, R. W. Burpee, A. S. Fry, G. H. Hickox, W. H. McAlpine, T. B. Parker, C. M. Spofford.

Judson, Frederick, Jun., Ellenville, N.Y. (Elected Aug. 17, 1931.) (Age 31.) With Board of Water Supply, City of New York acting as Asst. to Sec. Engr. at Lackawack (N. Y.) Dam. Refers to H. R. Bouton, H. A. Dibbell, M. F. Freund, A. E. Hilliard, C. G. Hoerner, Jr.

Kelson, Mihills Olie Courtney, Jun., Bonneville, Ore. (Elected Nov. 10, 1930.) (Age 32.) Office Engr., U. S. Engr. Dept., 2nd Portland Dist., Portland, Ore. Refers to C. I. Grimm, A. L. Henny, R. E. Mackenzie, B. S. Morrow, B. E. Torpen.

Newmark, Nathan Mortimore, Jun., Urbana, Ill. (Elected Oct. 29, 1934.) (Age 27.) Research Associate in Civ. Eng., Univ. of Illinois. Refers to H. Cross, M. L. Enger, W. C. Huntington, H. N. Lendall, B. Moreell, F. E. Richart, H. M. Westergaard, W. M. Wilson.

Nichols, George Henry, Jun., Charleston, S.C. (Elected May 23, 1932.) (Age 32.) Senior Eng. Draftsman, U. S. Corps. of Engrs. (War Dept.). Refers to J. W. Barnett, L. F. Bellinger, B. M. Hall, Jr., F. H. McDonald, R. W. Torras, C. C. Whitaker.

Parker, Charles Fulton, Jun., South Windham, Maine. (Elected Oct. 1, 1928.) (Age 32.) Jun. Engr., Maine Highway Comm. Refers to H. S. Boardman, H. B. Drowne, W. S. Evans, S. C. Hollister, E. M. Hunt, H. N. Ogden.

Pickett, Charles Marvin, Jr., Jun., Jamaica Plain, Mass. (Elected Oct. 1, 1926.) (Age 32.) Draftsman, Park Dept., Boston, Mass. Refers to J. B. Babcock, 3d, C. B. Breed, P. M. Churchill, J. R. Lambert, C. M. Spofford, J. B. Wilbur.

Poppe, Charles Raymond, Jun., Red Bluff, Calif. (Elected Oct. 10, 1927.) (Age 32.) Res. Engr., Bridge Dept., Div. of Highways, State of California. Refers to J. Gallagher, I. O. Jahlstrom, H. E. Kuphal, F. W. Panhorst, H. J. Whitlock.

Rasmussen, Howard Burnett, Jun., Chicago, Ill. (Elected Oct. 10, 1927.) (Age 32.) Field Auditor (Senior), Traffic Audit Bureau, Inc. Refers to H. E. Babbitt, R. C. Benson, J. J. Doland, W. C. Huntington, R. W. Olmsted.

Roberts, John Donald, Jun., San Francisco, Calif. (Elected Dec. 3, 1928.) (Age 32.) Hydr. Engr. and Designer, City of San Francisco. Refers to W. H. Allen, L. B. Reynolds, J. Skytte, L. W. Stocker, F. H. Tibbetts, J. H. Turner, N. F. Yde.

Smith, Thomas Alexander, Jun., Austin, Tex. (Elected Aug. 17, 1936.) (Age 32.) Refers to J. A. Focht, L. C. Ingram, Jr., T. B. Ingram, H. N. Roberts, J. W. Stewart, J. E. Taylor, G. G. Wickline.

Updyke, Gerald Austin, Jun., Manila, P.I. (Elected Oct. 14, 1930.) (Age 29.) Chf. Draftsman and Designing Engr., Atlantic, Gulf & Pacific Co. Refers to O. A. Boni, S. Garmezy, F. W. Garran, E. C. Holbrook, A. P. Richmond, Jr., G. F. Sparhawk, J. A. Thomas.

Vaughan, James Waverley, Jun., Nashville, Tenn. (Elected Jan. 13, 1930.) (Age 32.) With Tennessee Elec. Power Co. Refers to C. W. Haasis, R. B. Newman, Jr., C. E. Ramser, J. J. Richey, H. T. Van Valkenburgh, W. H. Wilson.

Waldbillig, Gerald William, Jun., Albany, N.Y. (Elected May 25, 1931.) (Age 32.) Pres., John B. Waldbillig, Inc. Refers to J. Dyer, R. G. Finch, R. S. Holmgren, C. T. Middlebrook, E. H. Sargent.

Wells, Joseph Van Brunt, Jun., Harrisburg, Pa. (Elected June 9, 1930.) (Age 31.) Asst. Engr., U. S. Geological Survey. Refers to N. C. Grover, A. W. Harrington, H. F. Hill, Jr., J. L. Lamson, J. W. Mangan, C. G. Paulsen, P. R. Speer.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1937 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Structural-Architectural Engineer; Assoc. M. Am. Soc. C.E.; graduate civil engineer, University of Pennsylvania; registered engineer; 3-year evening course in accounting; 17 years varied experience in building construction; past 9 years with leading architect. Structural and architectural designing, detailing, approving shop drawings, supervising construction, etc. Responsible charge. Excellent references. Location preferred—vicinity of Philadelphia or New York. C-137.

Civil Engineer; M. Am. Soc. C.E.; 10 years on location, design, and construction of highways; 4 years on railroad and bridge construction; 5 years on design and construction of sewer systems, water works, and school buildings; 1 year on heavy-factory construction; 4 years hydraulic and flood-control work. Available immediately. C-136.

Civil-Hydraulic-Construction Engineer; Assoc. M. Am. Soc. C.E.; married; 35; B.Sc.; M.Sc.; Chi Epsilon; California Junior College Teachers Certificate; 6 years teaching mechanics, hydraulics, surveying; 8 years in analysis, design, and construction of hydraulic works and highways. Now employed. Permanent position with engineering-contracting firm or university with opportunity desired. C-152.

Construction Engineer; M. Am. Soc. C.E.; general superintendent; 25 years experience in building construction work—supervised some of finest and fastest work of this kind in this country. For 7 years average cost of work, 4 million dollars. Perfect health; abundance of energy; can produce results. Will go anywhere. Available at once. C-160.

Executive

Civil Engineer; Assoc. M. Am. Soc. C.E.; registered engineer; 10 years experience and contacts in municipal and private construction, mines, and chemical and steel plants. Employed at present as chief engineer in charge of design and construction and engineering sales for Eastern manufacturer. Will consider change. Prefers West or foreign country. C-139.

Civil Engineer; M. Am. Soc. C.E.; 50; married; experienced executive; college education. Designer of timber, steel, and reinforced concrete structures, gravity and arch dams; 25 years experience. In responsible charge of $8,000,000 highway and bridge-construction projects. Seeks position as construction engineer or executive. Pacific Coast states preferred. Available on two weeks notice. C-147-3510-A-1-San Francisco.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 34; dependents; B.C.E., Ohio State University; registered in Ohio; 9 years experience on sewerage works of great magnitude; 1 year on flood control. Available on reasonable notice. C-149.

Civil Engineer, Executive; M. Am. Soc. C.E.; registered engineer, Pennsylvania; construction engineer; 25 years experience in railroad construction, municipal work, and building construction, as engineer in charge, also as contractor. Experienced in handling correspondence and directing activities of office and drafting room. Desires position in responsible charge. C-150.

City Manager or Purchasing Agent; M. Am. Soc. C.E.; 67; graduate of Ohio State University, 1893; 17 years in municipal work as city manager, director of public service, city engineer, and purchasing agent; 10 years on railroads as division engineer; 13 years in private practice. Southeast territory preferred. C-151.

Junior

Civil Engineer; Jun. Am. Soc. C.E.; 27; B.S. in C.E., 1931; Sigma Tau honorary; registered professional engineer; married; 4 1/2 years on design and construction of highways; 9 months on irrigation construction; 8 months in CCC duty, U. S. Army. Experienced draftsman. Location immaterial, but prefers southwestern United States. Available on reasonable notice. C-138.

Civil Engineer; Jun. Am. Soc. C.E.; 30; married; B.S.C.E., Missouri School of Mines, 1933; 3 years experience on river and harbor survey and construction work. Employment with an engineering or contracting firm desired. Available November 1, or on two weeks notice. Location immaterial. C-140.

Civil Engineer; Jun. Am. Soc. C.E.; 28; married; 7 years varied experience; 1 year in railroad work; 6 months with U. S. Corps of Engineers; last 4 years in Soil Conservation Service as junior and assistant engineer. Desires position offering opportunity for advancement. Available on short notice. Location immaterial. C-141.

Civil Engineer; 23; Jun. Am. Soc. C.E.; B.S.C.E.; married; 1 month surveying; last 7 months as draftsman and designer in railroad work on tracings, track layouts, wiring plans, profiles, steel and catenary design. Desires position with future. Location in the East preferred. Employed. Available on reasonable notice. C-142.

Civil Engineer; Jun. Am. Soc. C.E.; 25; single; B.S. in C.E.; M.S.; member Tau Beta

Pi, Phi Kappa Phi, Sigma Xi; 3 years practical experience in aerial photo-surveying and mapping. Desires teaching position: photogrammetry, structures, surveying, mathematics, hydraulics. C-145.

CIVIL ENGINEER; Student Member; 21; B.S.C.E., Manhattan College, 1937; Alpha Phi Delta; experienced surveyor, topographical draftsman, designer in concrete and steel; knowledge of Italian. Principally interested in surveying, design, or construction; however, will accept work in any branch of civil engineering. Available immediately. Location immaterial if salary is reasonable. C-146.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; B.S.C.E., Rhode Island State College, 1931; Army reserve officer, 4 years active duty with CCC, including 1½ years experience as inspector of construction and maintenance; desires position with future in air conditioning or in an engineering firm. C-143.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S.C.E.; 2 years electrical installations; 1 year general computations and drafting; 1 year as surveyor (transitman for General Land Office). Will accept low salary and learn useful work with a future. Interested in structures and better homes. Will go anywhere. C-148.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 31; married; D. Eng., Rensselaer Polytechnic Institute. Advanced study of elasticity, structures, mathematics, dynamics; 2 years diversified experience in surveying, structural drafting, mapping, design; past 2 years in responsible charge of difficult road location. Desires permanent connection with structural or general engineering firm or consultant with future in design or research. C-153.

CIVIL ENGINEER; 24; B.S. in C.E., Cooper Union Institute of Technology, 1935. One year as rodman on precise city survey; one year as steel designer for consulting engineer. Special research in, and author of, articles on indeterminate structures. Employed, but job completed. Available immediately. C-154.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S. in C.E., Manhattan College, 1932; 2½ years as chief of party and assistant engineer; 1 year in complete charge of conducting soil tests. Extensive reading on soil mechanics. Desires position with firm engaged in soil investigation, highway, or foundation work. C-156.

MISCELLANEOUS

APPRAISAL AND OFFICE ENGINEER; Assoc. M. Am. Soc. C.E.; 56; licensed engineer, New York and New Jersey. Long experience in valuation of railroads, bridges, subways, water-works properties, and buildings, including investigations and reports; 15 years in building construction, estimates, and office engineering. Previous general engineering experience in concrete and bridges. C-144.

CIVIL AND HYDRAULIC ENGINEER; Assoc. M. Am. Soc. C.E.; M.S.E., University of Michigan, 1930; licensed professional engineer; reciprocal registration; captain, Corps of Engineers, U. S. Army; reports on flood control and water power; research work in hydrology and hydraulics; designed dams, walls, and spillways; design and construction of bridges and highways; excellent health. C-159.

TEACHING

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; New York state license; Columbia University, 1908; desires teaching position. Qualified to teach mathematics, all branches of civil engineering, including surveying and statically indeterminate analysis by Beggs deformeter method. Experienced in structural steel and reinforced concrete design and construction in connection with subways, tunnels, bridges, especially skewed arches, and rigid frames. C-158.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; married; B.S. in C.E., Pennsylvania State College, 1933. Experience in railroad and highway surveying; tool and machine design work. Desires position teaching in engineering school. Location immaterial. Reasonable salary. C-157.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 77 of the Year Book for 1937. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

APPLIED GEOPHYSICS. By H. Shaw. London, Science Museum. Published by His Majesty's Stationery Office, 1936. 102 pp., illus., 10 × 6 in., paper, 2s. (Obtainable from British Library of Information, 270 Madison Ave., New York, 65 cents.)

This work is intended as a guide to the exhibit of geophysical apparatus in the Science Museum, London. In addition to descriptions of the apparatus on display, the book contains a brief, nontechnical explanation of the various methods of geophysical surveying.

CIVIL ENGINEERING. By W. A. Mitchell. Washington, D.C., the Society of American Military Engineers, 1937. 784 pp., illus., tables, diagrs., charts, 9 × 6 in., leather, $5.

Prepared especially for the cadets at the U. S. Military Academy, this textbook aims to give a fair working knowledge of the principles and practice of engineering. Concise chapters on every phase of civil engineering are included. The volume is a revision of the textbooks written for the same purpose in 1884 and 1904.

THE COLORADO DELTA. By Godfrey Sykes. New York, American Geographical Society of New York (Broadway at 156th St.), 1937. 193 pp., illus., tables, diagrs., charts, maps, 10 × 7 in., cloth, $4.

This is Special Publication No. 19 of the American Geographical Society, undertaken by the author under the joint sponsorship of the Carnegie Institution of Washington and the American Geographical Society of New York. The author's survey is based on personal observation extending over a period of forty-five years and provides a uniform and continuous survey of the rapid changes that have taken place in this area during that time.

ENGINEERING MECHANICS STATICS. By S. Timoshenko and D. H. Young. New York and London, McGraw-Hill Book Co., 1937. 334 pp., diagrs., tables, 10 × 6 in., cloth, $2.75.

A textbook intended to give a thorough grounding in statics for an engineer in any field. Subjects belonging more properly to courses in strength of materials have been omitted. The general considerations are of plane forces, space forces, and the principle of critical displacements, practically illustrated with reference to trusses, joints, etc.

EVERYDAY SCIENCE. By A. W. Haslett. New York, Alfred A. Knopf, 1937. 317 pp., 8 × 5½ in., cloth, $2.75.

This is a highly readable book on science as it affects our everyday life. The author has covered as wide a field as possible, his topics ranging from such engineering interests as heating, ventilating, and refrigeration to "science and crime," food and disease. He has also emphasized the close connection between laboratory science and its applications and suggested some of the social questions raised by any study of science.

LA FATIGUE DES MÉTAUX. By R. Cazaud and L. Persoz. Paris, Dunod, 1937. 190 pp., illus., diagrs., charts, tables, 10 × 7 in., paper, 75 frs.; bound, 95 frs.

This monograph analyzes the principal studies of the fatigue of metals and presents the results in form for use by engineers and metallurgists. The theories of fatigue in metals, methods of testing, fatigue limits, the factors that affect fatigue, and the resistance of welded and riveted joints are discussed. Bibliographies accompany the various chapters.

FORTIFICATION. By William A. Mitchell. Washington, D.C., the Society of American Military Engineers, 1937. 216 pp., illus., tables, diagrs., charts, 7 × 4½ in., leather, $2.

This text is a revision of other books formerly used in the course in fortification at the U. S. Military Academy. There are chapters on trenches, the construction of defenses, the history of land and sea defenses, and many other pertinent subjects.

Great Britain Department of Scientific and Industrial Research. REPORT OF THE BUILDING RESEARCH BOARD FOR THE YEAR 1935. London, His Majesty's Stationery Office, 1936. 176 pp., illus., diagrs., charts, tables, 10 × 6 in., paper (obtainable from British Library of Information, 270 Madison Ave., New York, $1.10).

Included in this report are summaries of the investigations carried out during the year in the fields of building materials, structures, strength of materials, and the efficiency of buildings, and those upon various special problems. A list of the reports and other publications of the year is appended.

GRUNDSCHWELLEN, eine Massnahme gegen Wasserspiegel- und Sohlensenkungen. Untersuchungen aus dem Flussbaulaboratorium der Technischen Hochschule Karlsruhe. By H. Straub. Munich and Berlin, R. Oldenbourg, 1937. 64 pp., illus., diagrs., charts, tables, 11 × 8 in., paper, 5.20 rm.

This report, which emanates from the Hydraulic Laboratory of the Karlsruhe Technical High School, is a study of flow over sills and the effect of sills upon stream beds. The report gives the results of extensive model tests with stationary and moving stream bottoms, together with the results of experience with sills in rivers. The influence of various arrangements of sills upon erosion was determined.

SHOPPING DISTRICTS. By S. R. De Boer. Washington, D.C., American Planning and Civic Association (901 Union Trust Bldg.), 1937. 112 pp., illus., diagrs., charts, 9 × 6 in., fabric.

In this beautifully illustrated little volume the author shows that the location of shopping districts is an integral part of city planning and a major consideration in the determination of zoning districts. He emphasizes the fact that the retail dealer must offer the shopper comfort, convenience, and beauty in the facilities of buildings and equipment.

VDI-FORSCHUNGSHEFT 385, July–Aug., 1937. Grundlagen der Wassermessung mit dem hydrometrischen Flügel, by W. Henn. Berlin, VDI-Verlag, 1937. 22 pp., illus., diagrs., charts, tables, 5 rm.

A report upon an investigation of the screw-type current meter, carried out in the Hydraulic Laboratory of the Dresden Technical High School. The theory of the meter, its calibration, and the determination of its hydrometric constants are discussed, as well as its design and construction. Its reliability for stream gaging is considered. A bibliography is included.

VDI-LÜFTUNGSREGELN. Regeln zur Lüftung von Versammlungsräumen, ed. by Verein deutscher Ingenieure. Berlin, VDI-Verlag, 1937. 10 pp., diagrs., tables, 12 × 8 in., paper, 1.50 rm.

These "rules" present recommendations for the ventilation of assembly rooms, prepared as guides for architects, builders, and contractors.

WHO'S WHO IN ENGINEERING, a Biographical Dictionary of the Engineering Profession, 4 ed. Edited by W. S. Downs. New York, Lewis Historical Publishing Company, 1937. [illegible] pp., 10 × 6 in., cloth, $10.

This volume contains brief professional biographies of the leading professional engineers of America, based upon information supplied personally and therefore authoritative. Twelve thousand engineers are included, 14 per cent more than in the previous edition, and all biographies have been revised and brought up to date. A geographical index is included.